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SOME OBSERVATIONS OF MASTOID STRUCTURE AS REVEALED BY ROENTGEN-RAY EXAMINATION*

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THE material reported in this paper is the result of some study in the past two years by Dr. F. N. Bigelow of Providence, and the writer. This work was suggested by Dr. Bigelow as a result of his disappointment with the general literature available on mastoid structure. He has made a more detailed report on the study, which will be published elsewhere.

A large part of the clinical literature on mastoid disease published in the past few years regards the mastoid as having essentially a definite type of structure. The authors speak of mastoid disease as if it were really an entity, and discuss the different stages and modes of treating mastoiditis. As a matter of fact an infection of the mastoid is one of the most

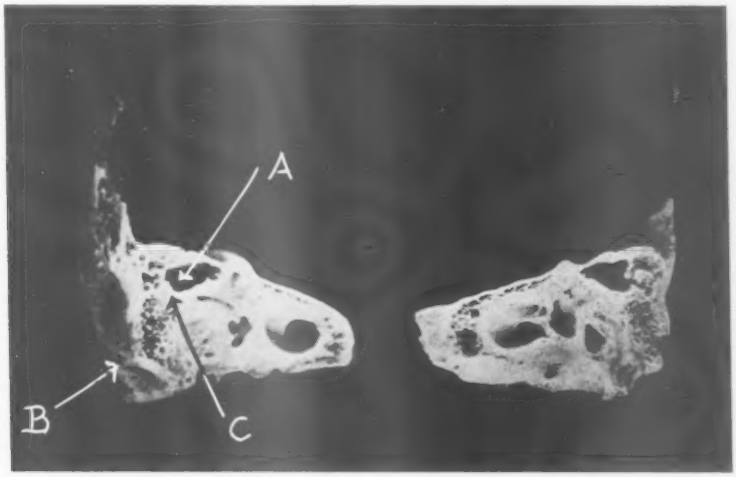

FIG. 1. (AFTER CHEATLE.)

Right temporal bone of an infant aged nine months, showing the diploëtic type of mastoid mass in infancy. A = middle ear and antrum, B = mastoid mass, C = outer antral wall.

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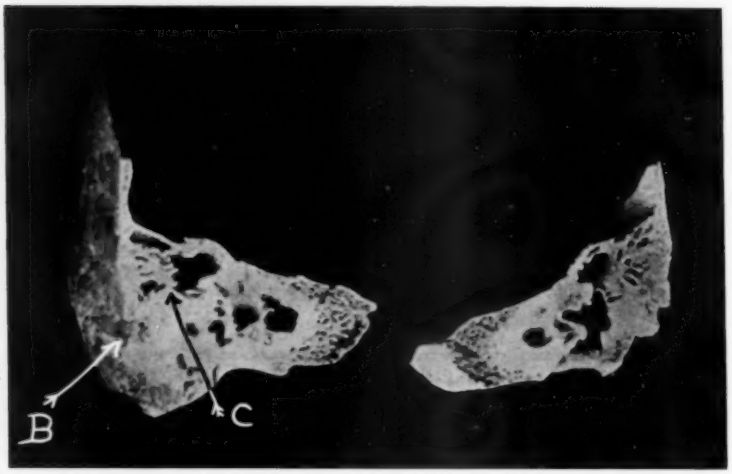

FIG. 2. (AFTER CHEATLE.)

Temporal bone of infant aged seven months, showing the dense type of mastoid mass. B = mastoid mass, C = outer antral wall.

protean types of disease with which we are acquainted. Specialists with wide experience have come to realize that every case of mastoid infection is a problem in itself; that the clinical course and the indications for surgical interference are widely varied; and that one case can very rarely be compared accurately and in detail with another. Each case presents a distinct problem and a distinct special study. The basis for this wide variation seems to be most probably the existence of marked fundamental differences in mastoid structure.

The use of the roentgen-ray examination in the study of mastoid disease is undoubt-

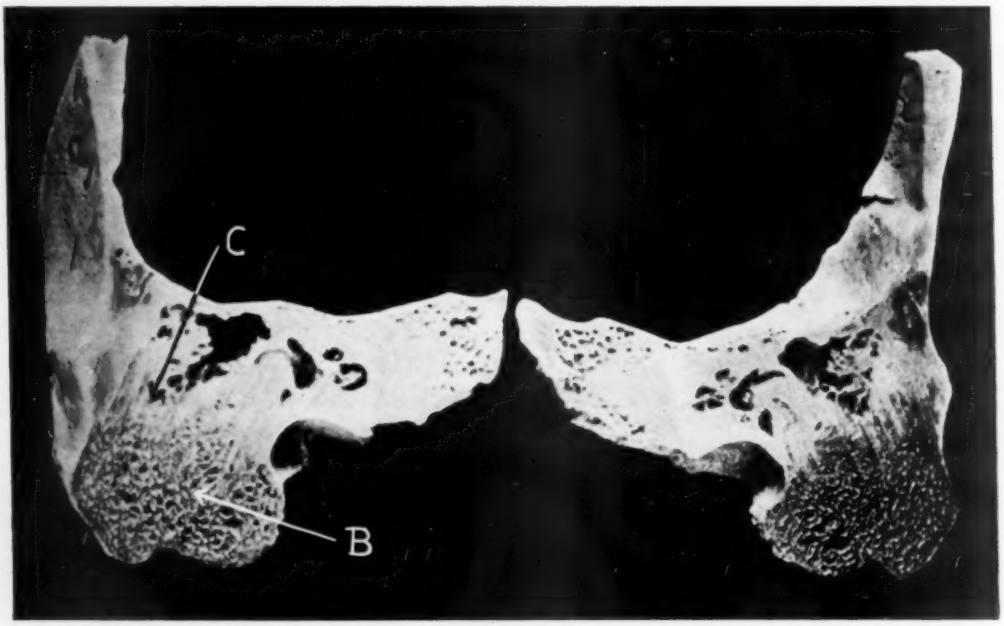

FIG. 3. (AFTER CHEATLE.)

Temporal bone of adult aged 42, showing the persistent diploëtic infantile type. B = mastoid mass, C = outer antral wall.

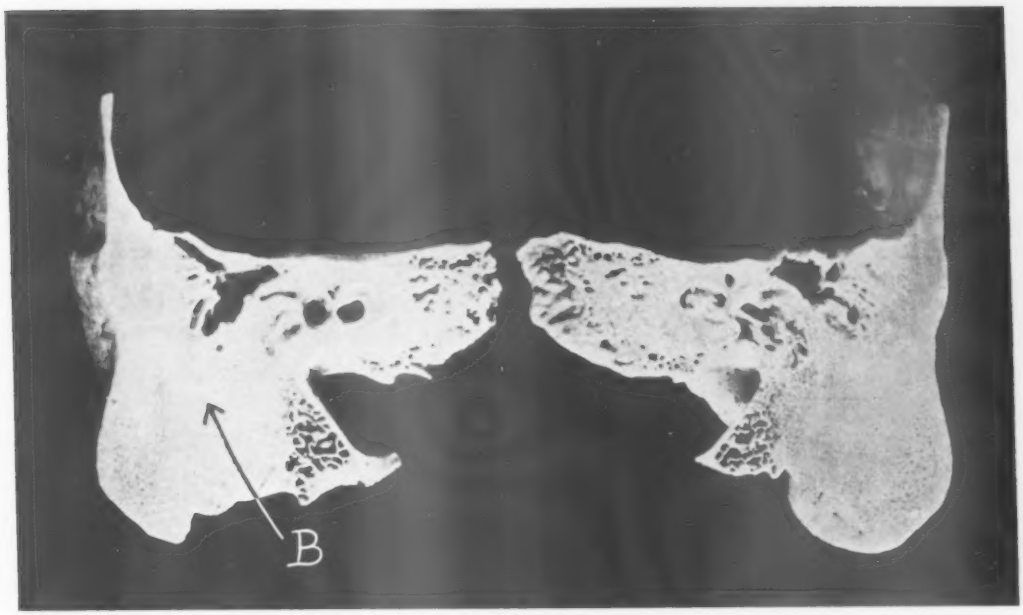

FIG. 4. (AFTER CHEATLE.)
Temporal bone of adult, showing the persistent dense infantile type. B = dense mastoid mass continuous with the outer antral wall.

edly a tremendous help. The pioneer work done by members of our society, notably Lange[1] and Pirie[2], has been of the utmost value in the early detection of mastoid changes. Up to the present, however, the data available through use of the roentgen-ray examination have been chiefly concerned with the size, distribution and approximate number of the mastoid cells, the character of the cell-walls, and the location of the lateral sinus. Little attention has been paid to the general type of mastoid structure.

An attempt has been made to classify the various types, from the roentgen-ray point of view, but this has been slight. The usual classification has been into three groups, the Pneumatic, Diploëtic, and Mixed types. Unfortunately, this classification, while affording some knowledge of the general structure of the mastoid, has not been of any real value to the otologist. It did not aid him either in planning his operation, or in getting an idea of the prognosis in the individual case.

Some years ago, Cheatle[3], an English observer, examined a large number of temporal bones for the purpose of determining the types of mastoid structure in both the normal and pathologic states. The results of his work, while easily available, have not received much notice from the otologists on this side of the Atlantic. It was from an acquaintance with Cheatle's work that Dr. Bigelow was first impressed with the importance of the study of "type" in mastoid structure, and suggested our observation of these types as revealed by the roentgen-ray examination.

Cheatle divided all mastoid structure into two main groups, the Infantile and the Pneumatic types.

In order to appreciate just what the infantile type means it is desirable to study for a moment the structure of the mastoid region in the young infant. (Figs. 1 and 2.) In such a mastoid, a lateral vertical section shows the outer wall of the mastoid antrum to be composed of two essential parts. There is an outer layer of compact bone, known as the outer antral wall, and inside this is a layer of so-called "fetal cells." Below, and external to the antrum, is the mastoid mass itself. This mastoid

FIG. 5.
A right infantile mastoid, probably Type 1.

mass is generally of two types. In one, the mass shows more or less diploëtic structure. (Fig. 1.) In the other it is extremely dense, with very little structure to be made out. (Fig. 2.)

Now by the "infantile" type of mastoid Cheatle means the persistence of that type throughout adult life, where the appearances of the outer antral wall and the mastoid mass are practically the same as the above-mentioned conditions in infants. As there are two types of infantile mastoid, so there are likewise two general types of infantile mastoid which persist into adult life.

The first type is the diploëtic form of persistent infantile mastoid. This condition was found by Cheatle to exist in about 20 per cent. of all the mastoids which he studied. Such a mastoid in the adult will present an entirely diploëtic condition of the main portion of the body of the mastoid, and an extremely thick and dense outer antral wall. (Fig. 3.)

The second infantile type is the "dense form" as seen in adult life. (Fig. 4.) This is not a very common type, however, and is only seen in one or two per cent. of the temporal bones studied by Cheatle.

These two types of persistent infantile mastoid can thus be seen to make up nearly one-quarter of all the mastoids observed. The common characteristic of these infantile types is the dense outer antral wall. The lateral sinus is generally much more forward than is common in the cellular type of mastoid. It may even reach the posterior meatal wall, or be found between the cavity of the mastoid antrum and the surface. (Fig. 6.) In this type of mastoid the size of the antrum is variable. When it is large, the dense wall will be found only in the anterior portion, while the posterior wall is apt to be very thin. This latter wall is very close to the cerebellum or the lateral sinus.

The operative difficulties in attacking such a mastoid can easily be imagined. The antrum is very hard to find on account of its thick wall which may involve the entire mastoid mass; and complications with the floor of the cerebellum, the lateral sinus, the labyrinth or the facial nerve are not uncommon.

A third type of infantile mastoid is described by Cheatle, consisting essentially

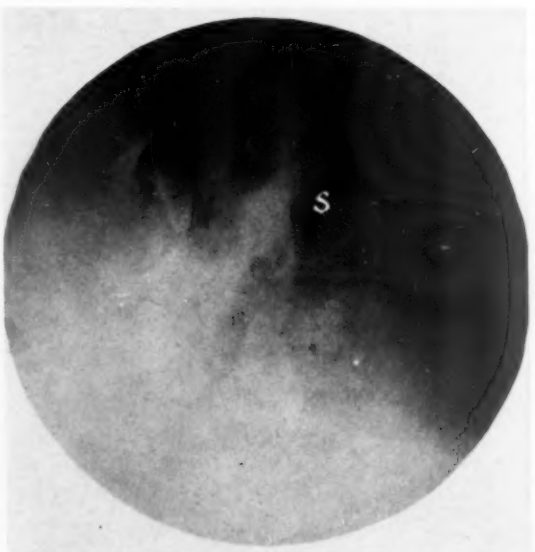

FIG. 6.
A right infantile mastoid, probably Type 2. Several small cells seen back of middle ear. S = lateral sinus, which was found to be extremely superficial at operation.

of a combination of the infantile and pneumatic types, with the infantile characteristics predominating. (Fig. 7.) This may sound rather like an academic distinction. But when I mention the infantile characteristics as predominating, I have clearly in mind the fact that the clinical significance with an infantile type of mastoid is quite different from that encountered in the ordinary pneumatic type.

An acute infection of the mastoid generally starts as an infection of the antrum, by spread from the middle ear through the aditus antri. (Fig. 10.) In the infantile type, with its thick outer antral wall, an infection can continue and develop for a long time with practically no visible external mastoid signs. It may even go on until there are intra-cranial complications through the thin posterior wall, without giving any very marked superficial indications. The natural result of such a course, if a brain abscess or a sinus-thrombosis does not intervene, is the production of a chronic suppurative mastoiditis. This is the bugbear of the otologists. A careful roentgen-ray study of the ordinary cases of chronic suppuration will show that the great majority of them have the infantile type of mastoid.

These cases then run a long subacute course, with very few violent or pressing symptoms. In Type 1 the diploëtic cells of the mastoid mass may eventually become infected through the blood-stream. When this occurs we may have the same sort of acute mastoid symptoms as exist with the pneumatic type, but the symptoms are never so threatening as in the latter, and not quite so prominent.

In the roentgen-ray study of infantile types of mastoid, the exact details of the mastoid structure cannot always be shown. This is obvious, because the penetration of the rays is obstructed by the thick wall, which in Type 2 is extended to a thickening of the entire mastoid. However, there is generally enough information available to be of marked clinical value and significance.

It is generally safe to assume that there is an infantile type present when the lateral sinus is seen far forward, when one finds a characteristic sort of cell distribution,

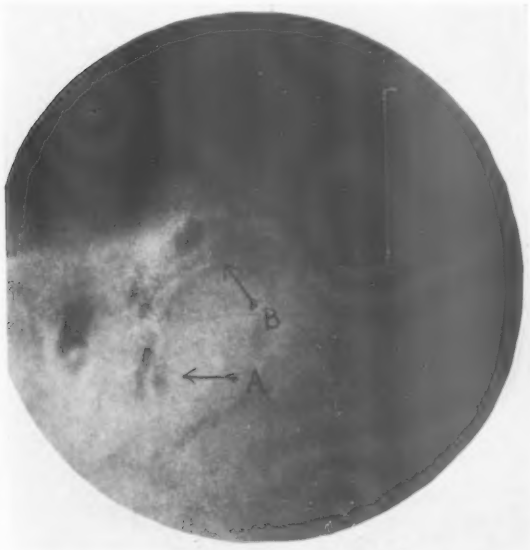

FIG. 7.

Right infantile mastoid in a man of 67, probably Type 3. A few large cells are seen in the tip (A), and along the squamo-mastoid suture (B), probably representing rudimentary pneumatic structure. Compare with Fig. 8.

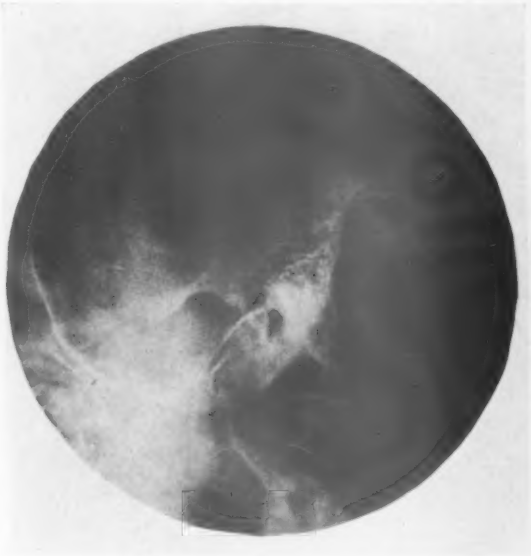

FIG. 8.

Right mastoid in a girl of eight, showing a few scattered large cells, probably rudimentary pneumatic structure. Compare with Fig. 7.

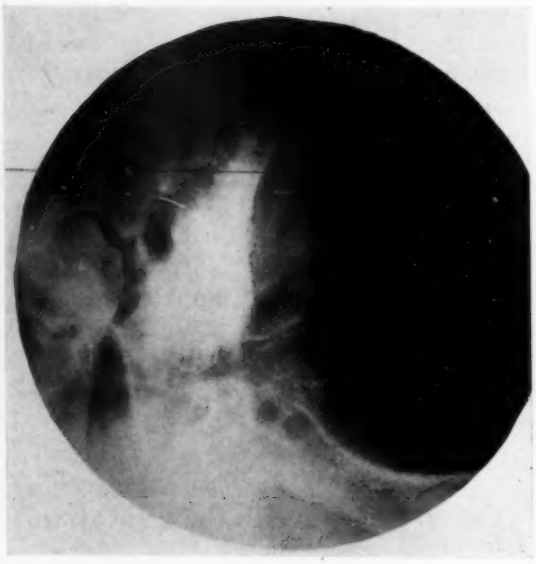

FIG. 9 A.

Probably a Type 2 infantile mastoid. At operation, a chronically infected antrum was found deeply situated in dense bone. The possibility of sclerosis cannot be ruled out here.

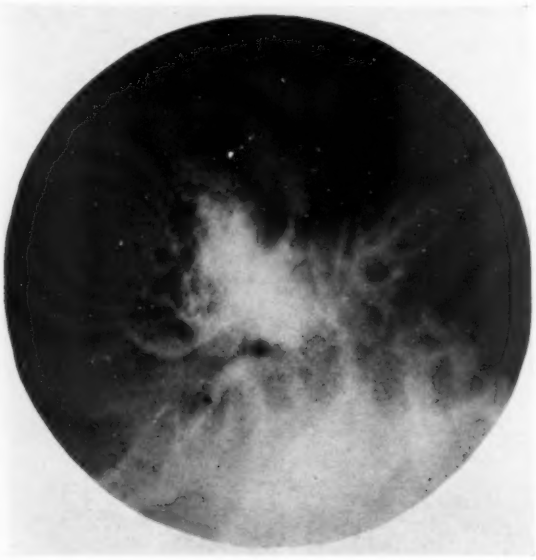

FIG. 9 B.

Normal mastoid, same case as Fig. 9 A. This mastoid is of the pure pneumatic type.

with only a few cells near the tip and a few back of the middle ear or only the latter. In the first instance we are dealing with a Type 1 infantile mastoid, and in the second instance with a Type 2. In such cases, from an understanding of the pathological possibilities, it is desirable to advise early exploration of the mastoid antrum. This is a relatively simple operation, which will avoid the possible complications or the possible transformation into a chronic infection.

The third type of infantile mastoid, in which there is a combination of dense wall with scattered pneumatic cells (Fig. 7), has all the dangers of the pneumatic type with regard to spread of infection, and yet with none of the safeguards that will be mentioned later in discussing the pneumatic type. This is one of the worst types of mastoid to encounter when diseased, and requires prompt antral exploration.

The Pneumatic type of mastoid develops from the infantile type by the projection and development of the antral cells into the mastoid mass through the outer antral wall. The process begins very early in life and progresses rapidly. Stewart[4] some time ago showed that this development of the pneumatic cells is a much earlier process than had been previously realized.

Cheatle divides the pneumatic types into three distinct groups, all of which have distinctive roentgen-ray evidences.

The first type is the pure pneumatic type. (Fig. 10.) It forms the great majority of the mastoids encountered. This is the well-known type in which we see large numbers of pneumatic cells with thin walls, extending throughout the mastoid distribution. The antral wall as a rule is relatively thin, and the tip of the mastoid is usually large, with the larger cells in this portion. Most of the roentgen-ray study has been concerned with this type of mastoid. Here, the evidences of acute infection are generally very obvious. The cells lose their black aërated quality, and appear hazy, due to the secretion. The thin cell-walls become indistinct in outline, and later show the effect of softening or actual destruction. It is in this type that the perisinus and epidural abscesses are brought out clearly by their distinctive shadows

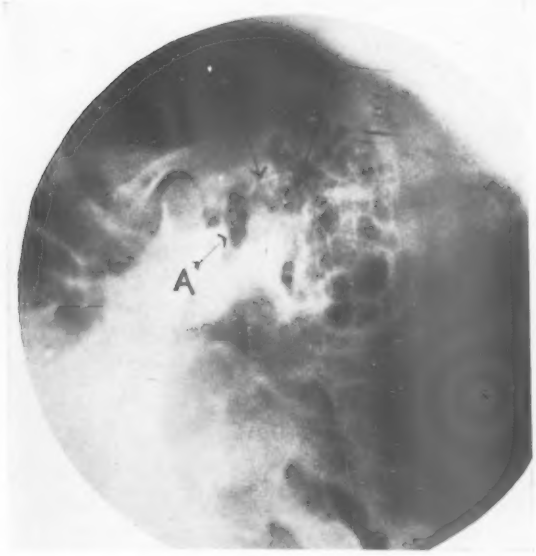

FIG. 10.

Type I pneumatic mastoid. This plate brings out clearly the anatomical details of the mastoid region. Note the relations of the middle ear (A), the aditus antri (B), and the mastoid antrum (C).

in the neighborhoods of the lateral sinus and the squamous bone, respectively.

In this type of mastoid, the onset of the infection is usually abrupt, because of the free communication between the antrum and the large ramifying system of cells. The antral infection generally extends directly into the cells, spreading rapidly to the outermost portions of their distribution. This general infection is responsible for the stormy and threatening symptoms which usually develop so quickly. Sometimes of course there may be a considerable amount of mastoid destruction in this type, without very many clinical symptoms, but it is not common. As a rule infections in this type are easy to recognize by means of the roentgen rays.

The distribution of the cells often brings on interesting complications. Very commonly the cells may extend far forward into the zygomatic process, so as to be in very close relation to the temporo-mandibular joint. (Fig. 11.) In such cases, the infection of these cells will produce a condition closely resembling lockjaw. I have had the opportunity of observing these jaw symptoms in about half a dozen cases, in all of which the mastoid cells were found to be in close relation to the joint. In one instance, a fracture of the zygomatic process of the temporal bone, which ordinarily would be a purely localized process, gave rise in a few days to an acute mastoiditis, from the infection of these anterior, atypically placed cells.

A total and complete destruction of the walls and cellular structure in the pneumatic type will often give rise to an appearance closely resembling the infantile type. Practically no mastoid structure is visible. Very often the differential diagnosis from the roentgen-ray plates alone between the total mastoid destruction and an infantile type is difficult; sometimes it is impossible. The position of the lateral sinus may be of value in the diagnosis. In the infantile type it occupies a more forward position than in the pneumatic type. Often, however, the clinical signs will be of value in the differentiation. Where there is marked mastoid tenderness early, with high temperature and threatening clinical symptoms generally, where the course has been of short duration, with an appearance resembling an infantile mastoid, the chances are

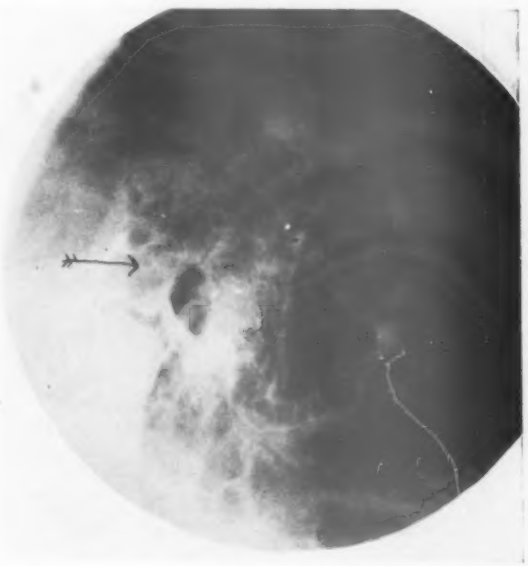

FIG. 11.

Type I pneumatic mastoid, showing zygomatic cells extending to the temporo-mandibular joint.

that total destruction of a pneumatic mastoid is more probable. In either case operative interference is certainly necessary.

In connection with the pneumatic type of mastoid, Dr. Bigelow has formulated an interesting theory to explain the frequent cures by repeated punctures of the drum membrane, especially in cases of large cellular mastoids. At the beginning of the middle-ear infection there is a swelling of the mucous membrane, with consequent obstruction of the Eustachian tube. This cuts off the communication with the atmospheric air. As a result, the air retained in the antrum and mastoid cells is soon absorbed and a condition of negative pressure is produced. This results in venous engorgement and an outpouring of serum. The latter is a fertile field for the development of organisms, and before long the infection spreads rapidly throughout the inflamed area. Now by means of puncturing the drum-membrane the outside positive pressure is reëstablished. As a result the venous engorgement is reduced, and the conditions favorable to infection are gradually removed. Generally this healing process is spoken of as a matter of drainage. If we consider, however, the arrangement of the cells, we can see that simple mechanical drainage does not explain the process. The theory of reëstablishment of positive atmospheric pressure, instead of the negative pressure which is present during the infection, seems a very plausible one. Very often simple repeated paracentesis will bring about a cure in this type of mastoid even though the clinical symptoms may have been marked.

The second pneumatic type is a combination of pneumatic and infantile types, with the pneumatic character predominating. This is the type in which the mastoid mass originally contained a large amount

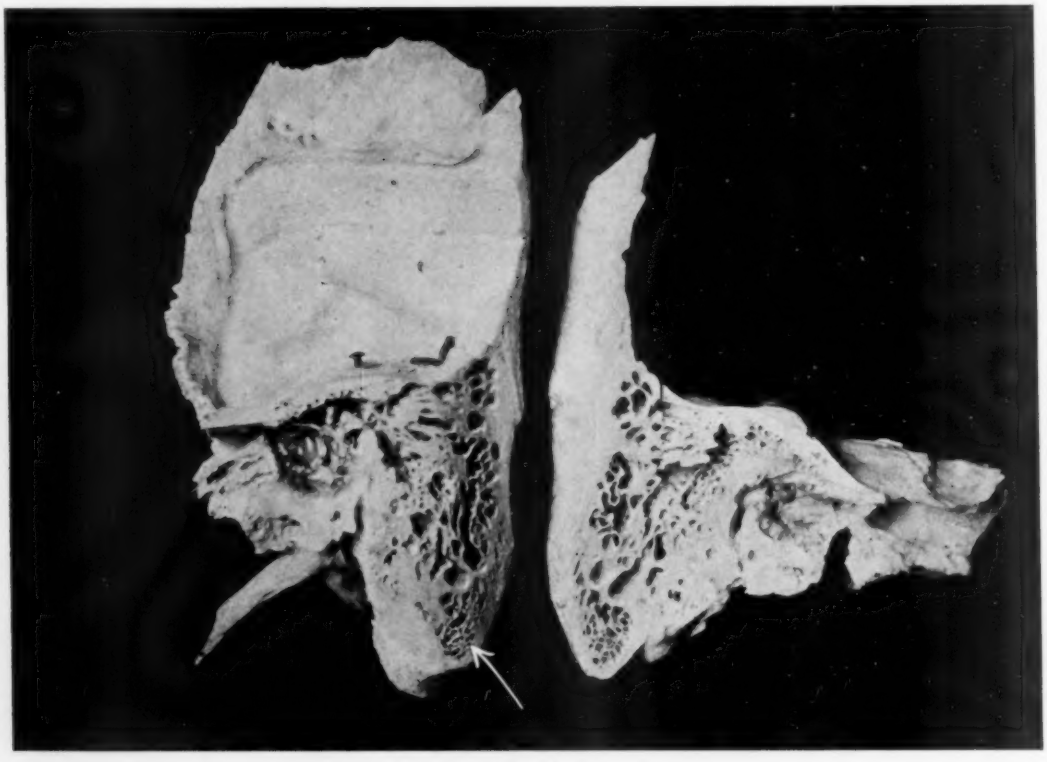

FIG. 12.

Photograph of a temporal bone, showing a nest of large diploëtic cells in the tip, separated from the pneumatic structure by a layer of compact bone. This is Type 2 pneumatic mastoid. Compare with Fig. 13.

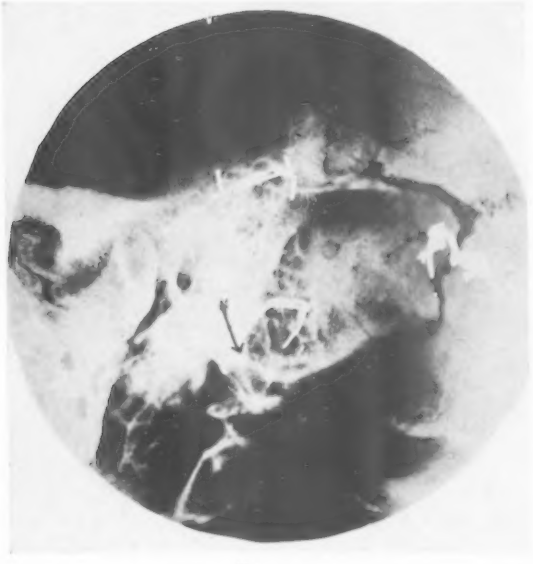

FIG. 13.

Print from roentgen-ray plate of bone shown in Fig. 12. The arrow points to the nest of diploë in the tip, separated by the layer of compact bone. This was much more evident when the plates were studied stereoscopically.

of diploë, which has been pushed downward by the development of the pneumatic cells extending from the antrum. (Fig. 12.) Generally the course of disease in such a mastoid is the same as in the pure pneumatic type, but conditions will be complicated by reason of the presence of the infected diploëtic cells. The recognition of this underlying diploëtic structure is very important, as an operation directed merely towards the mass of the pneumatic cells will not entirely relieve conditions. A secondary operation to drain the diploëtic structure may be necessary. If the combination type is recognized by the roentgen-ray examination, a single operation may be enough to remedy the infection.

The third pneumatic type is the so-called "double-deck" mastoid. This is probably another one of the variations of development in a mastoid with considerable diploetic structure. Here a false inner table is produced, by reason of having an outer layer of pneumatic cells, with an inner deep layer of diploëtic structure. In this type the operator will come down on what he believes to be the inner wall of the antrum, and stop his operation there when, as a matter of fact, a large amount of infected diploëtic structure lies underneath. The detection of such a mastoid,

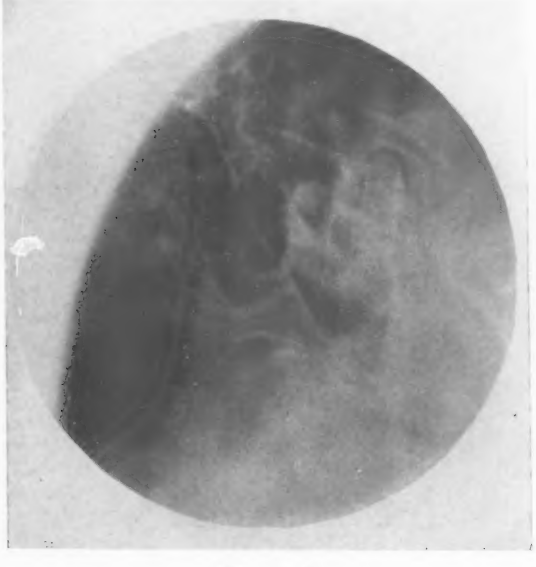

FIG. 14 A.

Left normal mastoid, of Type 1.

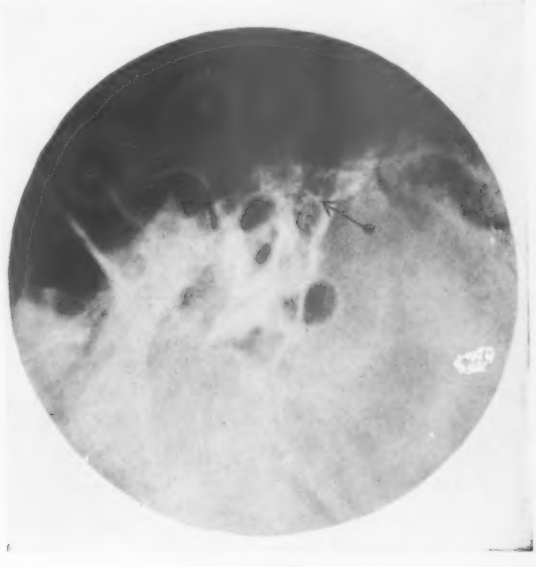

FIG. 14 B.

Right mastoid in same patient as Fig. 14 A. Arrow points to apparent diploëtic structure. Stereoscopic study of the plates showed that this was really many large pneumatic cells superimposed.

while possible by roentgen-ray examination, is usually very difficult. In one case, where a previous operation had disclosed a "double-deck" mastoid, a subsequent stereoscopic roentgen-ray study of the other mastoid revealed a condition which was apparently also a "double-decker." At any rate the plates showed what seemed to be an outer layer of cells and a definite inner layer of thin diploëtic structure underlying. Since then two or three cases have been studied in which the "double-deck" condition has been suspected from the roentgen-ray examination alone, and in one case it has been confirmed at subsequent operation.

The consideration of this last type brings out the important point that for a proper roentgen-ray study of these various types of mastoid structure a simple flat plate of the mastoid region is not sufficient. Such a plate may serve generally to bring out the ordinary types of infection visible in the pure pneumatic mastoid, but it will not disclose the complicating types, and will not clearly bring out the infantile types. A stereoscopic study of each mastoid is absolutely essential to the proper interpretation.

One of the points that impresses the observer in the study of mastoid structure is the fact that bilateral symmetry is by no means a fixed rule. Generally, of course, if one type of mastoid exists on one side, the other mastoid will also be of the same type. But this cannot be taken for granted. Frequently a pure pneumatic type of mastoid will be found on one side, and an infantile type, with a dense mastoid mass, on the other. (Figs. 9 A and B.) In the latter instance an infection of the infantile side may produce a difficult case for diagnosis. The presence on the healthy side of a pneumatic mastoid will only be confusing, as it may lead the observer to infer a similar type on the diseased side, and thus erroneously diagnose an extensive destruction on the affected side. In such a case, the clinical findings should be closely regarded, and the position of the lateral sinus studied.

Another important point is the condi-

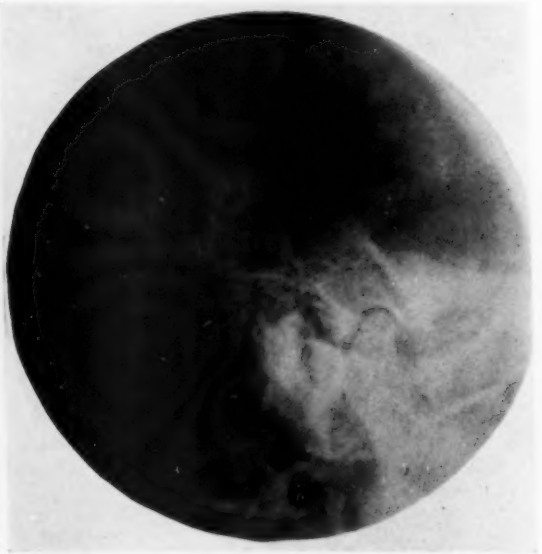

FIG. 15 A.
Normal left pneumatic mastoid, Type 1.

FIG. 15 B.
Right side of same patient as Fig. 15 A. The posterior portion and the tip show probable sclerosis, with a few scattered, hazy cell-remnants. The region of the internal ear (A) is unusually dense, suggesting possible old thickening.

tion of so-called "sclerosis," as detected by the roentgen-ray examination. It has been the habit of roentgenologists generally to speak of a mastoid as "sclerotic" when very little cellular structure was visible. The term sclerosis, when properly used, can be applied only to conditions where there has been actual inflammation, with subsequent repair and new bone production. Now while it is quite true that in some instances a previous infection with such repair has really existed, the majority of the cases that are called "sclerotic" are really mastoids in which no cellular structure was ever present. These are the cases of infantile mastoid that I have described above. A proof of this is the fact that the infantile condition has been found to exist in more than 20 per cent. of all mastoids. In other words, more than one-fifth of all mastoids never had any wide distribution of cellular structure at all. Therefore I believe that the diagnosis of sclerosis should be made very carefully and grudgingly, and always with the possibility in mind that we might be dealing with an infantile type. In this connection we must remember that the true distinction can only be made accurately by microscopic examination of the dense piece of bone after operation, to see if there are any evidences of pre-existing inflammation. However, the mere suspicion from the roentgen-ray study that we might be dealing with an infantile mastoid is enough to draw attention to the condition, and to put the otologist on guard against the possible hidden complications that may exist with this type.

To sum up then, the roentgen-ray examination of the mastoid, with due regard to the distinction of structural types, can help us to predict with much greater exactness the clinical course and prognosis of a middle-ear infection.

In the infantile types, by recognition of their presence, a chronic infection of the mastoid can be prevented by early drainage of the antrum, regardless of the absence of the classical mastoid signs. If there is merely a middle-ear suppuration, with definite drooping of the posterior-superior canal wall, and an infantile type of mastoid disclosed by the roentgen-ray examination, the patient should be given the benefit of the doubt by early antral exploration.

With the pneumatic type of mastoid, however, even in the presence of stormy symptoms, operation should not be hastened at the outset. The reëstablishment of positive mastoid pressure by means of proper punctures of the drum-membrane may be sufficient to produce prompt cure. Of course if actual destruction of the cell-walls, or the presence of a perisinus or epidural abscess, can be made out, then the indication for operative interference is definite.

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A CASE OF HYDRO-PNEUMO-CRANIUM, WITH AIR IN THE VENTRICLES

BY HOLLIS E. POTTER, M.D.

CHICAGO, ILL.

A REPORT of the following case is made available through the courtesy of Dr. B. F. Lounsbury of Chicago, whose associate, Dr. P. F. Thuresson, obtained the first set of roentgen plates. The patient was then referred to me for further observation, and later to Dr. Harold N. Moyer, who made a complete neurologic study.

On May 20, 1918, the patient, Mr. J. H., aged 40 years, fell from a height of 15 feet, striking mainly on his hands and face. He was taken to a hospital and was found to have sustained a fracture of the radius and dislocation of the semilunar, a fracture of the mandible, and a contusion of the forehead with probable skull fracture. There was no loss in consciousness and no more pronounced nervous symptoms than a bitemporal headache which lasted but a week. Since this time there have been a slight dizziness and a little positional discomfort, particularly on bending the head forward.

The patient convalesced rapidly, so that on the nineteenth day he was sent to Chicago for some corrective work on his jaw and wrist. In the routine roentgen-ray examination of his injuries, the skull plates disclosed a frontal skull fracture which could be described as a comminuted, somewhat stellate fracture, centering about the right supra-orbital arch, and involving both the internal and external walls of the frontal sinus and the orbital plate, without appreciable depression of fragments. Inside the cranium, at the site of fracture, there was evidence of gaseous accumulation, in volume and shape comparable to a small hen-egg (see Fig. 1). This was considered rather startling, since the patient's head injury had at all times been in the background, practically all symptoms being those referred to the fractured jaw and wrist.

At this time, which, again, was nearly three weeks after the injury, in the absence of signs of hemorrhage, infection or intracranial pressure, it was decided not to interfere surgically, but to keep the patient under observation, and to make such further studies as would be permitted without danger to the hair and skin. So far, the appearance was that of a simple intracranial air-bubble, quite similar to that reported by Skinner under the title, "Intracranial Aerocele." In the latter case there intervened meningitis and death, thus preventing subsequent observations which might have disclosed the fate of the cavity and the fate of the air. Our interest in the present case centered about the later studies which were made possible by the continued life and health of the patient.

After an interval of two weeks, conditions had changed appreciably. There was considerable increase in the volume of the sub-dural gas chamber, and the lateral ventricle was also partially gas-filled. These facts were demonstrated by laterally projected plates made with the patient lying on his side (see Fig. 2). But in these plates there was not the high degree of transparency through the aerocele that there had been previously, which suggested strongly that the dependent portion of the cavity might contain fluid. Accordingly a screen examination was made with patient standing and head upright. In this position a distinct horizontal fluid level was seen, the fluid filling practically the lower half of the cavity. Now, using the well-known tactics for studying cavities which contain both air and fluid, the patient's head was placed in several successive positions, always with a horizontal fluid level resulting. (See Figs. 3 and 4.) Under the screen, the fluid could be seen to splash with any sudden movement of the head. The splashing was audible. As a record of these changes in fluid level, roentgen plates were made laterally through the head, both in the

sitting position and with head bowed forward on the table. It was thought advisable to use filters and intensifying screens for the protection of the patient.

From this time on the air disappeared, whether by absorption or expulsion is not certain, so that the screen and plate records of July 25 show no evidence whatever of the cavity. The exact date of complete disappearance was not obtained, owing to the temporary absence of the patient on a visit.

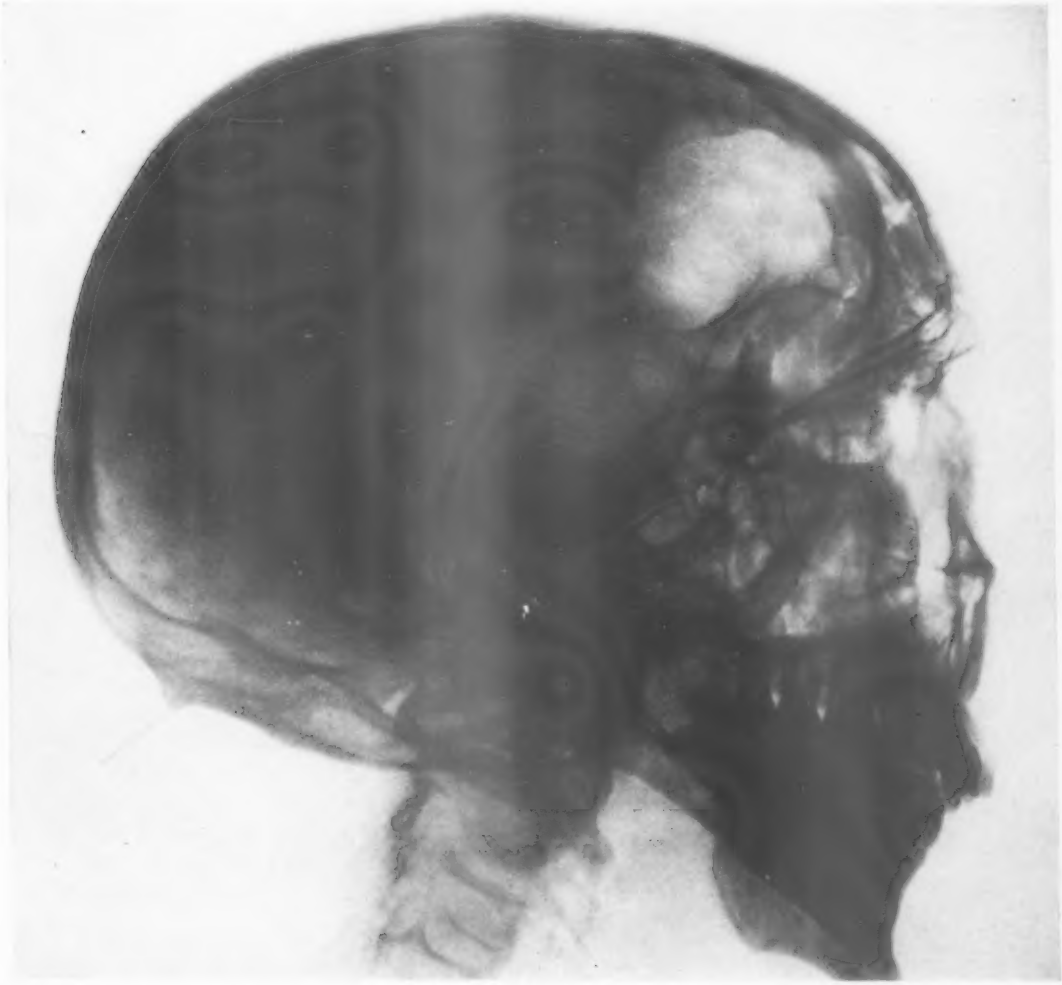

FIG. 1. DR. THURESSON'S DEMONSTRATION OF COMMINUTED SUPRAORBITAL FRACTURE AND INTRACRANIAL AIR-BUBBLE.

Cases of recognized intracranial air are extremely rare in the literature of medicine. The meningitis or abscess usually found on autopsy has made the presence of air interesting, mainly on account of its possible rôle in introducing infection. It is probable that many cases of intracranial air are overlooked because of the infrequency of roentgen-ray examination two or three weeks after the injury, where pneumatic sinuses are fractured into. Should this examination be made as a routine, I have no doubt that in a short time we should have a complete knowledge of the hydrostatics involved, with an answer to the speculative inquiry hereinafter contained as to the rôle of air in the formation of cavities which give symptoms long after-

ward and are classified among the traumatic cysts.

The mechanics of these cases should be considered alongside our previous knowledge of the external pneumatoceles, a review of which was made by McArthur in 1905. He collected 33 cases of which 23 were in relation to the mastoid, and ten to the frontal sinus. Ten developed after a trauma and in ten, also, there was evidence as occurring even in the middle of the last century, but they are not very illuminating.

Luckett, in his first case of air in the ventricles, mentions the appearance of air after a fit of sneezing, accompanied by a copious discharge of fluid from the nose. Stewart's notes show that there was no sign of intracranial air in this case on the first set of plates made after injury. Luckett

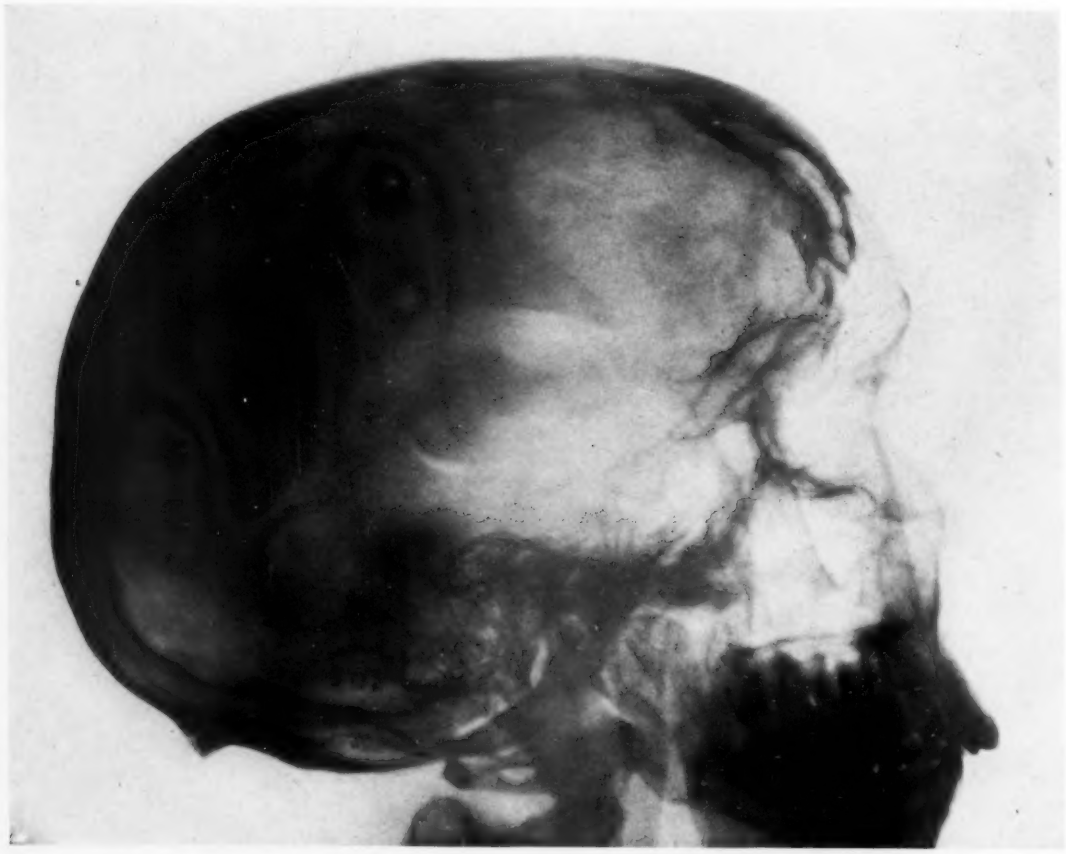

FIG. 2. MORE EXTENSIVE BUT LESS TRANSPARENT SUB-DURAL GAS CHAMBER WITH VISUALIZATION ALSO OF LATERAL VENTRICLE.

of pre-existing bone disease. Such bone disease was considered a predisposing factor to the development of pneumatocele after slight trauma. Besides trauma, some history of increased air-pressure in the buccal and oral cavities was frequently obtained. Before the days of roentgen rays, reports of intracranial emphysema and gaseous tumors of the brain are recorded concluded that air obtained direct entrance into the ventricles at the time of this rise in intrasinus pressure, and the autopsy confirmed the probability of this route by disclosing torn brain coverings and lacerated brain tissue. In our case of to-day, wherein there was first a sub-dural collection of gas and later a partial transfer to the ventricle, there is reasonable ques-

tion whether the air did not gain entrance to the ventricle by the roundabout passage formed by the foramina of Magendie and Luscka, the fourth and third ventricles and the foramina of Munro.

The character of the fluid in our case must be a matter of speculation, although in the absence of signs of infection, and in view of the fact that it appeared secondarily to the formation of the aerocele, it seems most probable that it was simple cerebro-spinal fluid. In this connection it is striking to note that the cubic contents of this cavity, roughly figured, were about 70 c.c. Frazier's average of the estimates of five investigators is about 95 c.c. for the total quantity of cerebro-spinal fluid. The estimates range from 62 to 150 c.c.

SUMMARY

Reviewing the succession of events in our recent case, we note that a number of days after the injury, air entered the cranial cavity. Two weeks later the cavity formed by this air had extended, but had become partially fluid-filled. With the entrance of fluid the cavity did not shrink concentrically, did not really become smaller as a cavity, but the air was gradually displaced by fluid, and it is no speculation that at this stage there existed a fluid-filled cavity very like a cyst. Judging from the completeness with which all gas disappeared, one would believe it had been expelled as well as absorbed, since a nitrogen residue is said to persist for some time after the oxygen content of air has become absorbed.

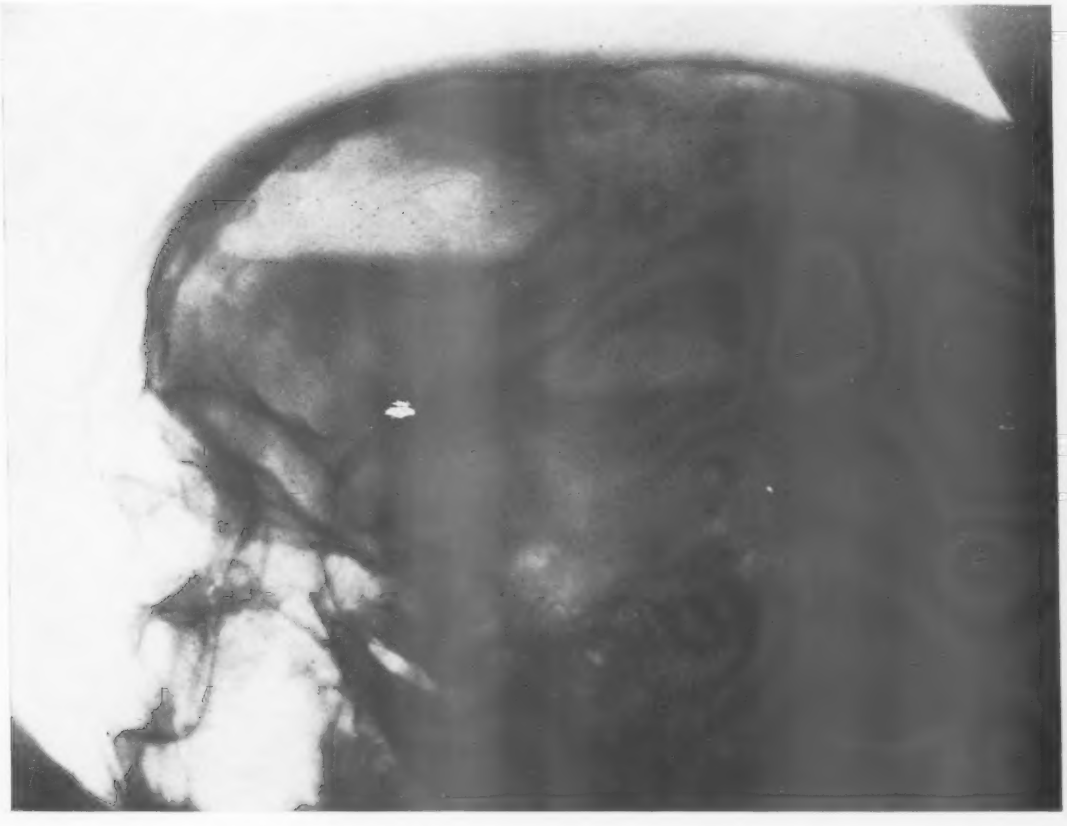

FIG. 3. AIR AND FLUID LEVEL SHOWN IN FRONTAL GAS CHAMBER AND IN LATERAL VENTRICLE, PATIENT SITTING UPRIGHT.

One is led to suspect from this chain of events that air insufflated into the cranial cavity, following fracture through pneumatic sinuses, could easily play an important rôle in the formation of certain traumatic cysts either filled with cerebro-spinal fluid alone or this fluid mixed with hematogenous elements. One would expect symptoms to arise from such cysts more often when in relation to the mastoid than to the frontal sinuses, whose adjacent frontal lobes are notoriously silent.

FIG. 4. PATIENT'S HEAD BOWED FORWARD ON THE TABLE. NOTE SHIFT IN FLUID LEVELS FROM THE POSITION IN FIG. 3.

A search through the literature on traumatic cysts reveals a few cases in which the above theory might well explain the original method of cyst formation. The following case, reported by Phemister in *Chicago Surgical Clinica* of October, 1917, is suggestive: A boy of 12 had been struck back of the ear by a wagon pole four and one half years previous. A bad fracture had been sustained which ran down to the mastoid, very possibly through it. Before operation, basal headaches had been present for one year and epileptic seizures for four months. Operation revealed a large cyst centering at the mastoid region. Phemister says:

> The method of cyst formation is also of great interest. We know from the history that the meninges and brain were lacerated—also that at operation the cyst extended deeply into the brain substance, apparently bordering on the lateral ventricle, and that no trace of convolutions could be seen on its walls. Hence it seems quite certain that the cyst developed within the injured brain substance. The source of fluid is a matter of conjecture, but it probably came from the choroid plexus, bordering on the inner wall. The cyst cavity was completely shut off by adhesions from the pia arachnoid space, consequently the fluid could not have come from this source.

In this case, if one assumes that air might have played a rôle in the formation of the cavity, it is easy to understand how the fluid may have gained entrance and become locked in by adhesions which formed either during, or subsequent to, its collection.

A ROENTGENOLOGIC CONTRIBUTION TO THE POSSIBLE CAUSE OF HEREDITARY OPTIC ATROPHY*

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HEREDITARY optic atrophy, or Leber's disease, may be described as a hereditary condition of unknown origin characterized by a partial or nearly total loss of vision. It may be of sudden or gradual onset, affecting males more frequently than females and occurring at certain rather definite periods of life. The characteristic features upon examination are an absolute central scotoma (Figs. 1-2); and by the ophthalmoscope a pallor of the disks, especially the temporal halves, without evidences of inflammatory changes such as exudates or hemorrhages. The retinal vessels are normal. Evidence points to a symmetrical retrobulbar etiological factor. The patient usually seeks the ophthalmologist because of failing vision. Leber suggested a neuropathic group of cases with additional secondary manifestations such as frontal headaches, vertigo, and epileptiform attacks.

History.—This disease has been recognized for a century. In 1871, Leber published an exhaustive monograph on the subject, collected all the cases in literature up to that time and gave to the condition the name of hereditary optic atrophy.

Onset.—It is usually quite rapid, but the time may vary from a week or two to several months between the first noticeable manifestations and the maximum loss of vision.

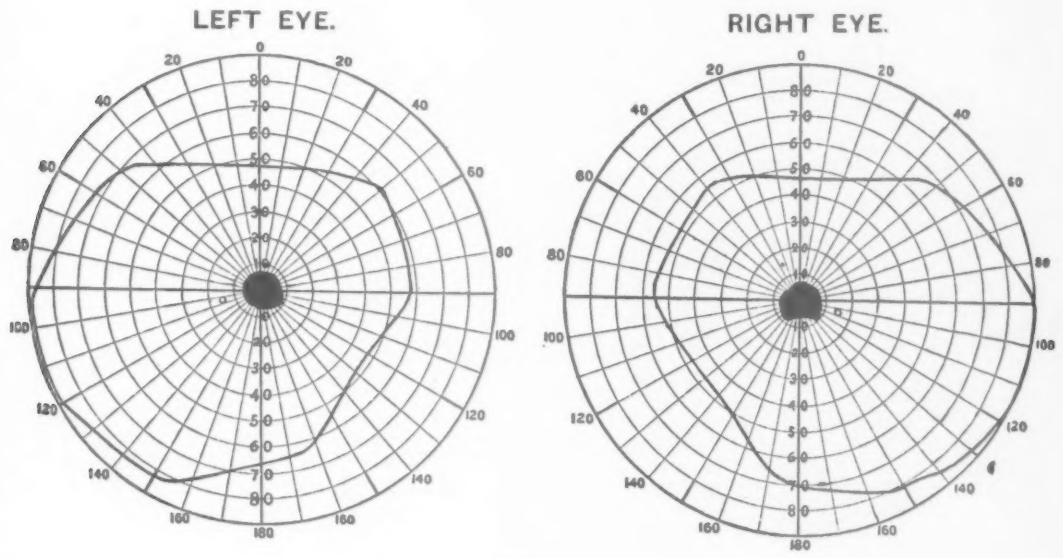

FIG. 1.

Age.—The earliest age for the attack is about the time of puberty. In males the condition is usually manifest in the second or third decade. In females it is perhaps more prone to occur at or about menopause. We have had occasion in the preparation of this article to refer to two

* Read at Nineteenth Annual Meeting of The American Roentgen Ray Society, Camp Greenleaf, Ga., Sept. 4, 1918.

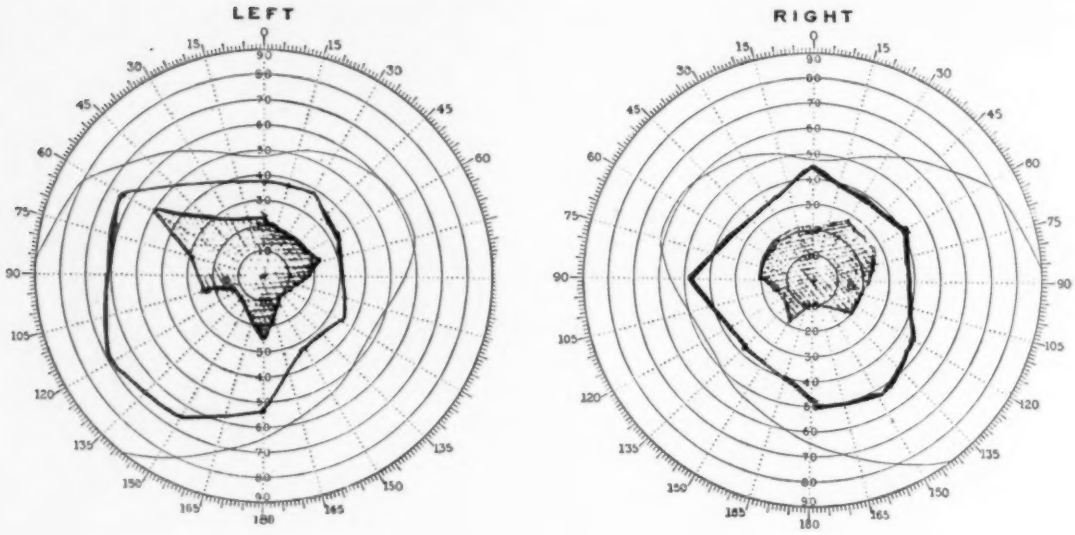

FIG. 2.

authors. In several generations of a single family, in the series of cases reported by Hancock[1] in 1906 (Fig. 3), the youngest was seventeen and the oldest forty-one. Fisher[2] reported a sister and brother affected at the ages of eleven and one-half and twelve years respectively.

Sex.—Usually only the male members of the family are affected and the condition is transmitted through the female members, as is generally the case with familial diseases. This is well illustrated in the accompanying diagram (Fig. 3) of the family tree of cases reported in Hancock's paper[1] published in 1906, which gives full references to literature up to that time. When females are affected, they may be attacked at the same ages as males, but are said to be more frequently stricken at or near menopause. According to Leber, the condition is more severe and more acute in females.

Prognosis.—Complete blindness is uncommon, the peripheral fields usually remaining intact, or contracted. Sight may be regained, frequently to a slight extent, occasionally to a considerable extent, and rarely almost completely. In the twelve cases in the family series of Hancock, six recovered, and this he states is a very unusual proportion. One eye may recover and the other one may not. None of our cases reported as affected typically has shown evidences of recovery.

Pathology.—The cause of the condition is not known. Tobacco, alcohol, or syphilis has little or no influence. Many reported cases were non-smokers, total abstainers, and the possibility of syphilitic infection could be eliminated. Whatever the cause, it must be retrobulbar, and if the chiasm is affected, or the tracts, it would have to be almost if not quite symmetrical. Our reasons for suggesting a possible etiological factor were: Firstly, by certain constant and fairly definite roentgen findings in several typical cases occurring in two different families; secondly, an apparent conformity between these findings and some suggestions as to the possible cause of the condition advanced by Fisher[2] in 1916. The hypothesis advanced in his article would seem to depend to a considerable extent upon future roentgen investigations, of which there seems to have been a dearth up to the present time.

Fisher calls attention to the facts that the phenomena observed in Leber's disease must be explained by retrobulbar changes comprising an atrophy following

a neuritis and affecting the two nerves symmetrically and practically synchronously on the one hand, and a hereditary tendency becoming manifest at certain ages on the other. The usual causes of retrobulbar neuritis are difficult or impossible to apply under such conditions. Cases of pituitary disease frequently develop a central scotoma with ultimately a hemianopsia by expansion, though this is not always the case as the scotoma often starts in the upper and outer part of the field and may later involve the macula. Fisher presents a hypothesis of a possible disturbance of the pituitary body of temporary duration and moderate degree as an explanation of the phenomena of hereditary optic atrophy. If such a condition were possible, the inherited tendency would seem to be more likely a liability of the pituitary body to a transient disorder than a special vulnerability of the macular fibres of the optic nerves to inflammatory attacks. If his hypothesis is in any way correct, facts must be discovered in support of it. If it be found correct, there might be some hope of combating the condition by organotherapy.

The following are the more important points advanced in support of Fisher's argument: There is a similarity between certain symptoms of pituitary disorders and the neuropathic type of Leber's cases—namely, frontal headaches, vertigo and epileptiform attacks. The pituitary functions are intimately related to those of the sexual glands and might be expected to be especially liable to inherited tendencies. Leber's disease very frequently is manifest at or about the age of puberty, and in the female not infrequently at the time of menopause. At the sexual epochs there may be changes occurring in the pituitary body as physiological processes; these processes may be exaggerated in Leber's disease, with tumefaction. During pregnancy the pituitary body may become enlarged, and hemianopia may result. The relations of the pituitary body and the chiasm are very close, with only the diaphragm sellæ between; the latter may vary greatly in density and be so thin as to permit a very slight enlargement of the gland to impair the function of the nerve. Cases of Leber's disease with glycosuria have been reported. It is alleged that in some reported cases with pituitary growths a very early, slight transient papillitis has been detected.

Fisher reported two typical cases of the disease, one a boy, in whom the condition was manifest at the age of twelve, and the other his sister, at the age of eleven and one-half years. In the former the roentgen

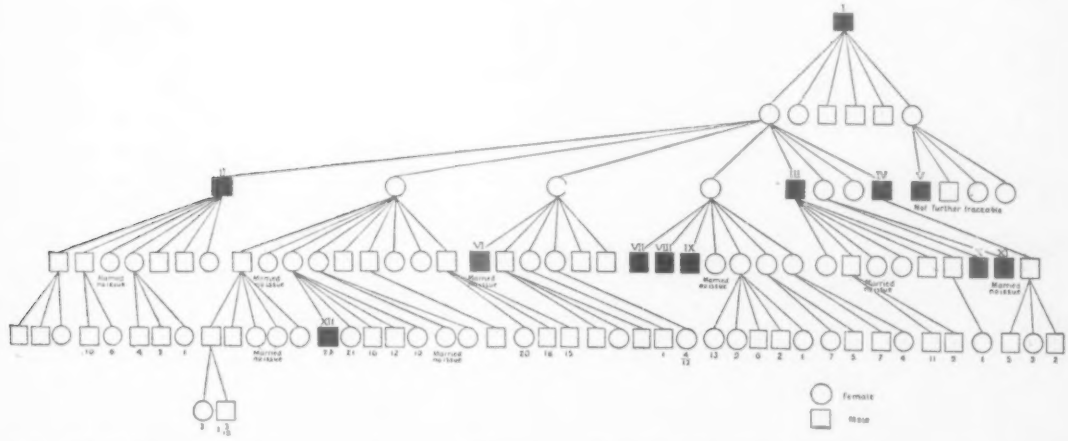

FIG. 3. THE BLACK SQUARES INDICATE AFFECTED MEMBERS. THE NUMBERS OVER THEM CORRESPOND WITH THE CASE NUMBERS IN THIS PAPER. THE FIGURES BENEATH THE LOWEST TWO LINES GIVE THE PRESENT AGE OF THESE MEMBERS OF THE FAMILY.

FIG. 4.

examination was negative. In the latter, repeated roentgenograms showed a sella without undue enlargement or deformation, but the fossa was filled in by a cellular honeycomb-like shadow and the appearance was regarded as distinctly abnormal. He believed that further roentgen study might throw some light on the etiology of the condition and lead to the determination of some corrective measures.

Since the publication of our own cases by Dr. William Zentmayer (3-4), our attention has been called to an abstract in the *American Journal of Ophthalmology* for August, 1918, of an article by Pollock, who reported two cases of Leber's disease occurring in a brother and sister. Roentgenograms of the sellæ showed almost identical appearances in both. This was a shadow about the size of a very small bean with the concavity downward and situated in and a little below the centre of the fossa. There was relative improvement following organotherapy. The reference was not given.

Through the courtesy of Dr. William Zentmayer we have had the opportunity of examining five cases of Leber's disease among the members of two families. We are indebted to Doctor Zentmayer for the privilege of reporting these cases in connection with the roentgen findings.

CASE I.—C. C., male, aged 30. Gradual failure of vision when 29. Typical manifestations of Leber's disease. A roentgen examination of the head was made during my absence. On looking over the plates subsequently, without knowledge of the condition, the pituitary fossa appeared noticeably large but not pathological and the case was passed as probably negative, since we were under the impression that a pituitary growth was suspected. Measurements on standard plate: A. P. dimension 10 m.m., depth 11 m.m. (Fig. 4).

CASE II.—J. C., male, aged 36, brother of Case I. Gradual failure of vision at 30. Typical manifestations of Leber's disease. Again, not knowing the exact condition for which the patient was examined, we reported a slight enlargement of the sella turcica, past the borderline of normal in depth and anteroposterior direction, probably indicative of a beginning growth. Measurements on standard plate: A. P. dimension 13 m.m., depth 12 m.m. (Fig. 5).

CASE III.—E. S., male, aged 23; second family. Gradual onset beginning at age of 20. Typical manifestations of Leber's disease. Roentgen report: Sella turcica large and deep and on the borderline of normal size. Floor and posterior clinoid processes thin, but not out of proportion to the base and vault. No deformation of posterior processes. Measurements on standard

FIG. 5.

plate: A. P. dimension 13 m.m., depth 12 m.m. (Fig. 6).

These three cases were informally reported before the Philadelphia Roentgen Ray Society, and it was the consensus of opinion of the members that the fossæ were certainly on the borderline of normal and possibly beyond. It was thought best to examine some normal members of the families for comparison before drawing any more definite conclusions. Three members of Family II were subsequently induced to come for examination by Doctor Zentmayer, with the following results:

CASE IV.—F. S., brother of Case III, aged 27 years. Gradual failure of vision at the age of twelve, which has not been recovered. Typical manifestations of Leber's disease (Fig. 2). Roentgen report: Sella turcica possibly within normal limits of size but about on the borderline. No evidence of unusual pressure. Floor and posterior processes thin, not out of proportion to the rest of the skull but distinctly thinner than the normal brother (Case V). Measurements on standard plate: A. P. dimension 12 m.m., depth 10 m.m. (Fig. 7). No other members of this family were known to have the disease.

CASE V.—C. S., third brother in Family II, aged 21 years, and exhibiting no evidences of Leber's disease. Roentgen report: Sella turcica undoubtedly within normal limits of size, and much smaller

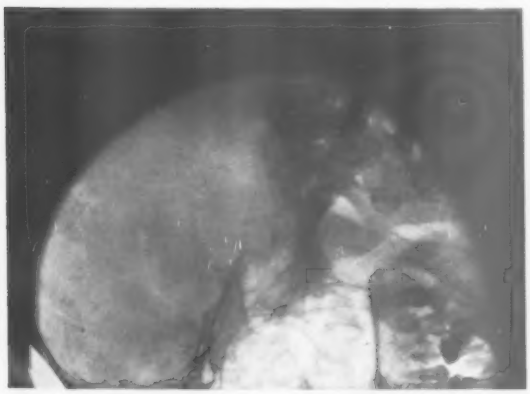

FIG. 6.

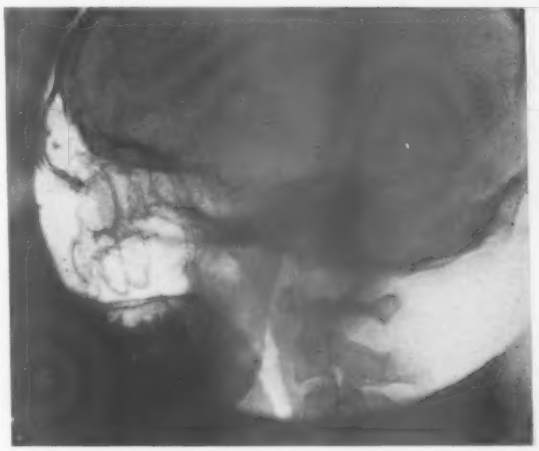

FIG. 7.

than in any of the other three members of the family. Floor and processes of normal thickness actually and relatively thicker than in the two affected brothers. Measurements on standard plate: A. P. dimension 9 m.m., depth 9 m.m. (Fig. 8).

CASE VI.—Mrs. M. S. E., married sister of Cases III-IV-V, aged 29 years. She was supposed to have no evidences of Leber's disease. Roentgen report: Sella turcica rather large and on the borderline of being abnormal in size. Floor and posterior processes much thinner than Case V, appearance practically the same as in the two affected brothers. Measurements on standard plate: A. P. dimension 12 m.m., depth 10 m.m. (Fig. 9).

Following the examination of the unaffected Case V, the roentgen appearances in all cases examined seemed to us very suggestive of a pituitary etiology for the condition. The examination of Case VI, however, a supposedly unaffected female, rather discouraged our views, until the fact was recalled that perhaps the majority of females do not exhibit manifestations of the disease until the time of menopause. This seemed a long time to wait for confirmatory evidence; nevertheless, we felt rather confident that this individual might become a victim later on. She became alarmed at the unusual interest shown in the others of the family, at the condition

FIG. 8.

already existent in her two brothers, as well as our request for an examination of her head, and consulted Doctor Zentmayer. She complained of "momentary obscuration of vision, a great deal of headache, and annoying sweating of the left side of the head." Report of Doctor Zentmayer: "Right optic papilla normal; the left showed all but the outer border obscured and slightly prominent. Central lymph sheath full. The visual fields showed decided concentric contraction for form and color, with a minute central relative scotoma in the right field, and an equally small paracentral relative scotoma in the left. Five days later no scotoma could be demonstrated in the left field." Neurological examination negative except for the left-sided sweating.

This case presented very suggestive evidence of pituitary trouble but not typical evidences of Leber's disease, though it seemed quite possible that the phenomena might be early manifestations of the condition in the fundus and field changes, but without optic atrophy. Under the circumstances, this case may be regarded as lending weight to our argument rather than against it.

Conclusions.—No satisfactory cause has been proven for hereditary optic atrophy. Fisher has advanced the theory that it might be due to a transient disorder of the pituitary body with enlargement occurring at definite epochs of sexual life. The roentgen examination would seem to be the most certain means of proving his contention, provided the enlargements were sufficient and of a necessary prolongation to produce a perceptible sellar deformation. Our studies of the affected members of two families would tend to lend weight to such an etiological factor, but cannot be regarded as proof positive.

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FIG. 9.

ROENTGEN-RAY EXAMINATION OF THE URETERS*

BY JOHN H. EDMONSON, M.D.

BIRMINGHAM, ALA.

HOW many of us some few years ago suffered the unpleasant looks and, many times, unkind remarks of our surgical friends when forsooth the cocksure ureteral calculus failed to reveal itself on a perfectly good roentgenogram. How many were relegated to the category of those unskilled in the art of interpretation before Kelly, Braasch, Furnis, Hunner and others demonstrated that here also symptoms could belie the finished touch of the roentgenologist.

The most prevalent ureteral conditions coming under the roentgenologists' observation are calculi, angulations and strictures.

The subject of calculi has been gone over so thoroughly within the past decade that it hardly behooves the writer to discuss it. Yet in passing, I want to emphasize the theory advanced by Hunner, of formation based upon local infection followed by gradual accumulation, rather than recent after formation within the pelvis.

Angulations may be the result of malformations in development, but as a rule the cause may be attributed to some traumatism, to adhesion from without the ureter or to dislocations of the kidney and hydronephrosis.

The symptoms produced by an angulation are very similar to other occlusions, but the urinary findings are less liable to show evidence of pathology. The pain produced is of a similar nature, but the passage of catheters is, in the average case, more difficult than in stricture.

The principal thing of interest occurring to me within the past two years in the ureteral region is the occlusion by stricture; its cause and variable effect.

To my mind, it is hardly practical to assert that this abnormality is due to any one cause; a stricture is nothing more nor less than scar tissue and from a standpoint of etiology may be divided into the traumatic and the infectious.

Under the traumatic, may be mentioned those produced by injury occurring during labor or surgical operations, in passing calculi, and from gunshot and stab wounds.

Under the infectious I shall include the tubercular and gonorrheal as well as that produced by a distal focal infection. To quote Hunner: "The majority of the ureteral strictures, excluding those of tubercular origin, should be classified as simple chronic stricture. They usually have their origin in an infection carried to the walls of the ureter from some distant focus such as diseased tonsils, sinuses, teeth or intestinal tract."

Symptoms.—The predominating symptom created by ureteral stricture is pain. In the average run of cases this can be traced by careful history to arise near the point of occlusion, but it is the unusual case that one should have in mind in all vague abdominal pains.

For example, what chance has an innocent appendix, should a pain occur deep seated in the right lower quadrant, especially where there is evidence of gastro-intestinal disturbance such as nausea and vomiting and aversion to food? Or the kidney is suspected, the appendectomy is delayed and urinary analysis shows a complete negative and a good clear roentgenogram declares 90 per cent against the presence of a stone; one knows just how much further the average investigation would go.

Of course in the average case of ureteral stricture the urine shows evidence of pathology, but a lack of this has no special significance. When pus is present to any great extent the symptoms are not so remote and can be found more definite in the kidney region.

*Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., September, 1918.

Where marked constipation is present, pain is often experienced in defecation.

In some instances the pain strikingly simulates pelvic inflammatory disease and is extremely difficult to differentiate. In other cases the pain cannot be described other than as a deep ache without definite location, and with negative urinary findings can readily be mistaken for almost any abdominal condition.

Some authorities claim that the roentgen-ray is not necessary for a diagnosis but is merely used as an adjunctive convenience. I fail to understand how differentiation can be made between the impression made upon a wax bulb by a stricture and by a small calculus which will permit easy passage. In all cases where the occlusion is sufficient to prevent anything more than an injection of thorium passing, I cannot see how any conclusion can be formed relative to the condition of the ureter and the kidney above.

I have nothing new to offer from a standpoint of technique, but wish to emphasize to beginners the extreme necessity of draining as thoroughly as possible all urine from the ureter and the kidney before injecting. I would also suggest that the catheter be withdrawn very near to where the stricture is suspected and, by a little suction on the syringe just before the plate is made, to fill the ureter as completely as possible with the injection.

This paper is a plea for making a routine practice of thorough ureteral investigation before operating upon cases which do not demand immediate attention.

CASE I. Miss L. W. Age 36. Has always suffered at time of menstrual periods. Has suffered continuously with indigestion for several years. Has been treated for all her symptoms, including bladder troubles, at times for more than six years. She has gradually lost weight and has never been entirely relieved of pain. She is referred as a gynecological patient with pain in left ovary and left upper abdomen, especially at or near time of menstrual periods.

Pelvic examination shows left ovary somewhat enlarged and very tender, otherwise normal. Urine drawn per catheter shows occasionally pus and red blood cells; hyaline cast found rarely. Complains of great pain in bladder at times, with constant desire to urinate in the afternoon and early part of night.

Operation shows the kink to be due to retroperitoneal adhesions from some previous inflammation (probably in the colon).

These adhesions are freed, ureter is sutured up in a straight line, the kidney left alone notwithstanding the fact that it is little lower than normal.

No other treatment carried out, but all symptoms are relieved and at the end of four months the patient has gained twenty pounds.

CASE II. (Courtesy of Dr. Hunner.) A case with almost impassable obstruction from below, but in which the characteristic "hang" and scar tissue grating on withdrawal of the wax-bulb were absent. The angulation was due to a fan-shaped band of adhesions suspending the sigmoid bowel to the posterior peritoneum. The adhesions probably followed a severe attack of typhoid fever during girlhood.

CASE III. Mrs. S. T. D. Age 28. Began three years ago to suffer with nausea and vomiting, swelling in abdomen and at margin of ribs on left side. Pain in left side of pelvis with constant desire to urinate. These symptoms would continue two or three days, then subside only to recur in a short time. There was at all times tenderness in left side from pelvis to ribs. This was thought to be due to complications at the time of, and immediately following confinement, three months previous.

The symptoms gradually grew worse and more constant until one year ago she submitted to laparotomy. The left tube, ovary and the appendix were removed, and the uterine ligaments were shortened. As

soon as she was out of bed all the old symptoms returned. She has been under constant medical care and has lost about twenty-five pounds before and since her laparotomy.

Pelvic examination.—Negative, but extremely sensitive in left side.

Bladder.—Urine per catheter shows some blood and large amount of pus. Cystoscope shows an inflamed bladder. Left ureteral orifice is inflamed. Right is normal. Number 6 lead catheter passes to kidney on right side without obstruction. Urine is normal. Left ureter after much manipulation admits a No. 4 lead catheter, blood and pus are both present. Roentgen-ray shows no stone. Silver iodide solution injected. Stricture of ureter dilated; all symptoms relieved.

CASE IV. Mrs. G. L. Age 34. Had a cæsarian section seven years ago. Laparotomy for double pyosalpinx three years ago. Two years ago began to suffer pain in left side around kidney, later in lower left abdomen, also pain in bladder.

Digestive disturbances soon followed. If perfectly quiet for a few days all symptoms are relieved, only to return when she is on her feet for a short time. She has been treated for all her symptoms including bladder irrigation, with only short intervals of relief.

For three months past has had temperature at irregular intervals up to 102° F. Has lost fifteen pounds in weight, complains intensely of digestive distress, pain in left abdomen and bladder.

Catheterized specimen shows few pus cells.

Stricture in left ureter dilated and all symptoms relieved.

CASE V. Mrs. R. C. Has had two operations. First, appendectomy. Second, pelvic operation. Not relieved of pain in lower right side. Urine: negative. Stricture located in ureter. Pain removed by dilation.

CASE VI. J. T. C. Passed small stone from bladder some years ago. Has had pain in side since that time. Urine: negative. Diagnosed as appendicitis and gall-stones. Injected kidney revealed ureteral stricture. Pain entirely removed by dilation.

CASE VII. Mrs. J. E. G. Suffered with pain in left side for two or three years. Two months pregnant. Hysterical convulsions. Sent in as epileptic. Urine contained some pus cells. Found stricture of left ureter. Dilated. Relieved of symptoms.

CASE VIII. Mrs. J. H. B. Suffered some years ago with pain in right lower quadrant. Was operated upon for appendicitis; no relief. Following year, oophorectomy. No relief. Some time later passed very small stone from bladder, and was free from pain until two years ago when similar pain in left side occurred. Negative stone findings. Ureteral stricture revealed. Dilated, all symptoms disappeared.

CASE IX. Miss S. 65 years old. Pain in left side costal margin for years which was always attributed to malarial spleen. Urine negative. Two strictures revealed. Dilated, symptoms removed.

CASE X. Mrs. H. Diagnosis—Gall-stones. Ureteral stricture revealed. Dilated and relieved of symptoms.

CASE XI. Mrs. J. W. J. Symptoms of gall-stones. Urine negative. Ureteral stricture high up. Dilated, symptoms entirely removed.

CASE XII. P. M. L. Intermittent pains in lower right side every month at time near but not immediately at menstrual periods. Ureteral stricture found. Dilation gave complete relief.

VENTRICULOGRAPHY FOLLOWING THE INJECTION OF AIR INTO THE CEREBRAL VENTRICLES*

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THE value of roentgenography in the diagnosis and localization of intracranial tumors is mainly restricted to the cases in which the neoplasm has affected the skull. In an analysis of the roentgen-ray findings in 100 cases of brain tumor from Doctor Halsted's Clinic, Heuer and I[1] have shown that in only 6 per cent. of the cases did the tumor cast a shadow, and in these it was only the calcified areas that were differentiated by the roentgen-rays from the normal cerebral tissues.

In those instances (9 per cent. of our cases) in which a tumor has encroached upon the sphenoid, ethmoid or frontal sinus, the invading portion casts a shadow in the roentgenogram. Such shadows are due to the displacement of the normally contained air by tissues which are less pervious to the roentgen-ray. This group of shadows is of minor practical importance because the growth can be recognized by the destruction of the walls or bony septa of the sinuses.

Since the roentgen-rays penetrate normal brain tissues, blood, cerebrospinal fluid and non-calcified tumor tissue almost equally, any changes in the brain produced by altered proportions of these components will not materially alter the roentgenogram.

Although skull changes are shown by the roentgen-ray in 45 per cent. of our cases and are frequently pathognomonic, on the whole they represent late stages of the disease. As intracranial tumors come to be diagnosed and localized earlier, the value of the roentgen-ray will be correspondingly diminished.

[1] Roentgenography in the Localization of Brain Tumor, Based upon a Series of One Hundred Consecutive Cases. *The Johns Hopkins Hosp. Bull.*, 1916, Vol. XXVII, p. 311. Also: A Report of Seventy Cases of Brain Tumor. *The Johns Hopkins Hosp. Bull.*, 1916, Vol. XXVII, p. 224.

For some time I have considered the possibility of filling the cerebral ventricles with a medium that will produce a shadow in the roentgenogram. If this could be done, an accurate outline of the cerebral ventricles could be photographed with roentgen-rays, and since most neoplasms either directly or indirectly modify the size or shape of the ventricles, we should then possess an early and accurate aid to the localization of intracranial affections. In addition to its roentgenographic properties, any substance injected into the ventricles must satisfy two very rigid exactions: (1) It must be absolutely non-irritating and non-toxic; and (2) it must be readily absorbed and excreted.

The various solutions and suspensions used in pyelography—thorium, potassium, iodide, collargol, argyrol, bismuth subnitrate and subcarbonate, all in various concentrations—were injected into the ventricles of dogs, but always with fatal results, owing to the injurious effects on the brain. Marked œdema, serosanguineous exudate, and petechial hemorrhages resulted. The severe reactions that are sometimes encountered after the intraspinous injection of most therapeutic remedies indicate the dangers even from carefully prepared solutions. A slight acidity or alkalinity may result even in death. It seems unlikely that any solution of roentgenographic value will be found which is sufficiently harmless to justify its injection into the central nervous system. Suspensions are precluded because they are not absorbed.

Ventriculography, therefore, seems possible only by the substitution of gas for cerebrospinal fluid. It is largely due to the frequent comment by Doctor Halsted on

* Reprinted from *Annals of Surgery*, July, 1918.

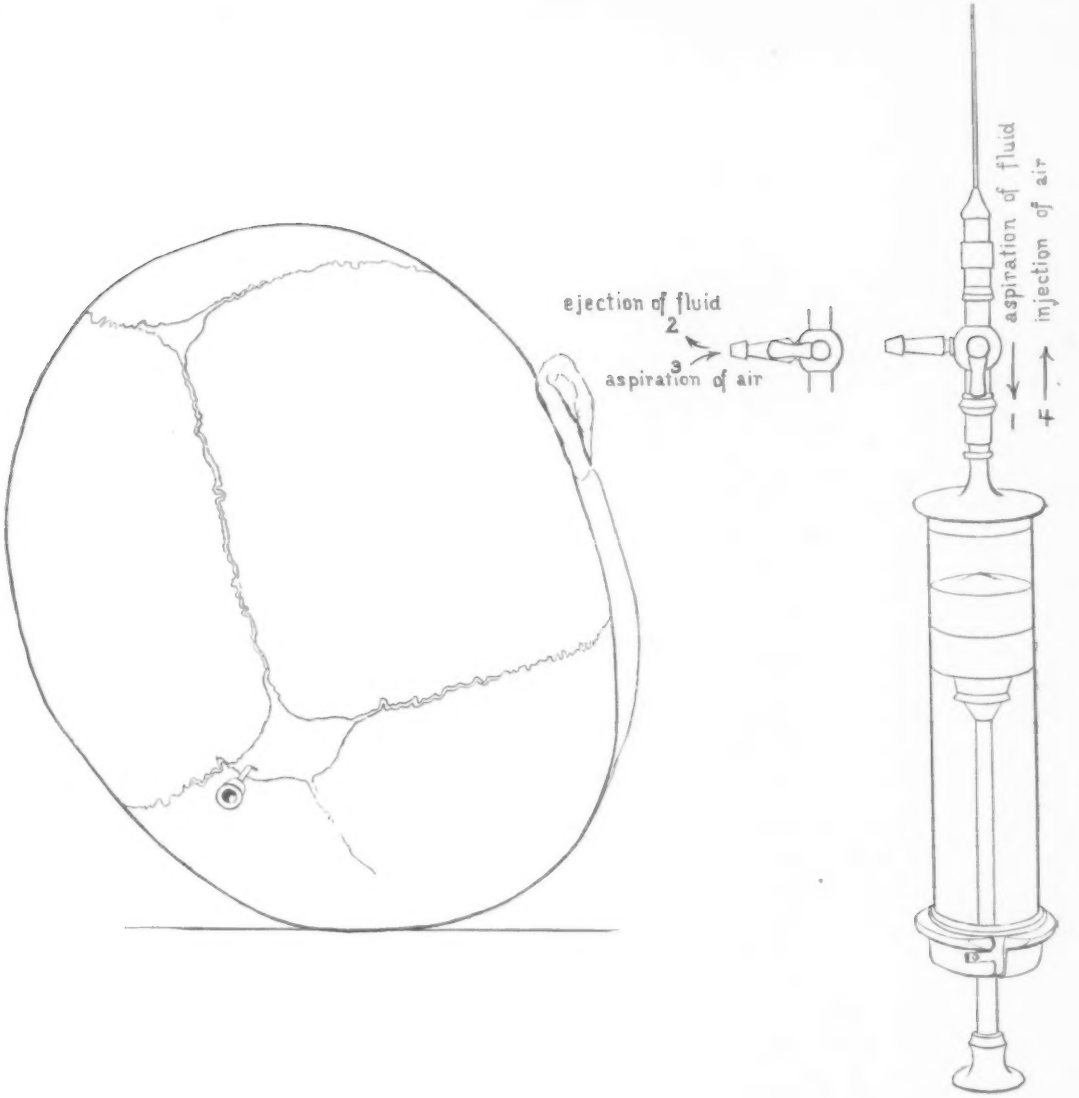

FIG. 1. Showing oblique position of head for aspiration of fluid and injection of air. The forehead is resting on plate. Note point of entrance of the needle into anterior fontanelle on dependent side. Figure on right shows Record syringe and two-way valve attachment used for this purpose.

the remarkable power of intestinal gases "to perforate bone" that my attention was drawn to its practical possibilities in the brain. Striking gas shadows are present in all abdominal and thoracic roentgenograms. The stomach and intestines are often outlined by the contained air, even more sharply than when filled with bismuth. A small collection of gas in the intestines often obliterates the kidney outlines. A perforation of the intestines may be diagnosed by the shadow of the air that has accumulated under the diaphragm. Gas gangrene may be diagnosed by the air blebs (of B. welchii) in the tissues. Pneumothorax is sharply outlined because the normal lung tissues are eliminated. The paranasal sinuses and mastoid air cells show up in a thick skull by virtue of the air, and pathological conditions of the si-

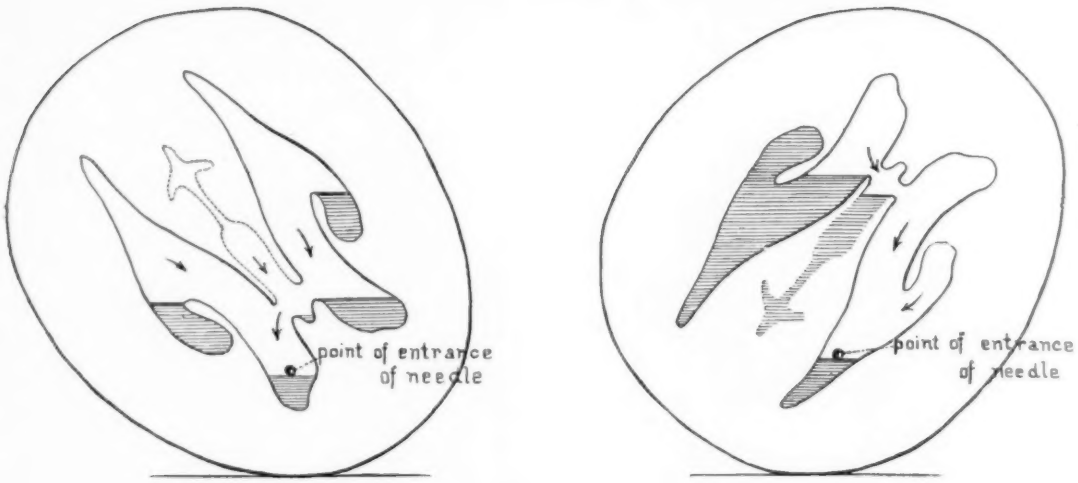

FIG. 2. Diagrams showing relative amounts of cerebrospinal fluid that can be removed from a single ventricular puncture: (1) when forehead is down (*a*), and (2) when occiput is down (*b*). Shaded area represents the fluid which remains in the ventricular system after the greatest possible quantity has been removed. Unshaded area represents maximum quantity of air which can be injected to replace the fluid withdrawn. It is evident that more fluid can be removed when the puncture is made anteriorly and the forehead is dependent.

nuses are evident because inflammatory or tumor tissue replaces the air. From these and many other normal and pathological clinical demonstrations of the roentgenographic properties of air it is but a step to the injection of gas into the cerebral ventricles—pneumoventriculography.

Methods.—Several gases are inert and readily absorbable, and in these respects satisfy the requirements for injection into the cerebrospinal system. Although it is possible other gases give even better results, we have used only air in the injections here described. The merits of other gases are now being studied.

In order to obtain a skiagram of the lateral cerebral ventricles filled with air, it is necessary to remove at least more cerebrospinal fluid than the contents of one ventricle and to replace this fluid with an equal quantity of air. Before closure of the fontanels, one can readily make a ventricular puncture through the interosseus defect. After union of the sutures, it is necessary to make a small opening in the bone.

Air and water in a ventricle behave exactly as they would in a closed flask. Following any change in position the fluid gravitates to the most dependent part and the air rises to the top. Owing to the free communication between the third, the right and the left lateral ventricles through the foramina of Monro, fluid and air will readily pass from one ventricle to the other. Because of the curves in the ventricular system, however, it is obvious that in any given position only part of the ventricular fluid can gravitate to the point of the needle, so that this amount only can be aspirated. If desired, fluid can be removed from the remaining recesses by tilting the head, just as one manipulates a curved tube to replace the fluid with air. Theoretically, it should be possible to remove nearly all the ventricular fluid by suitable manipulations of the head, but for practical purposes enough fluid can be obtained from one correct position. Visualization of the ventricular system will best indicate the most appropriate location for ventricular puncture and the proper position of the head. It will then be seen that the most fluid can be obtained from a puncture in the anterior part of either lateral ventricle (Fig. 2). The head

[NOTE.—*Explanation of Figures.*—Two pictures are shown in each figure number. The first one is the untouched photographic reproduction of the roentgen-ray plate; the other is the same photograph retouched, in order to overcome photographic loss of detail, and especially to emphasize the lines and special points which would otherwise be lost to the reader.]

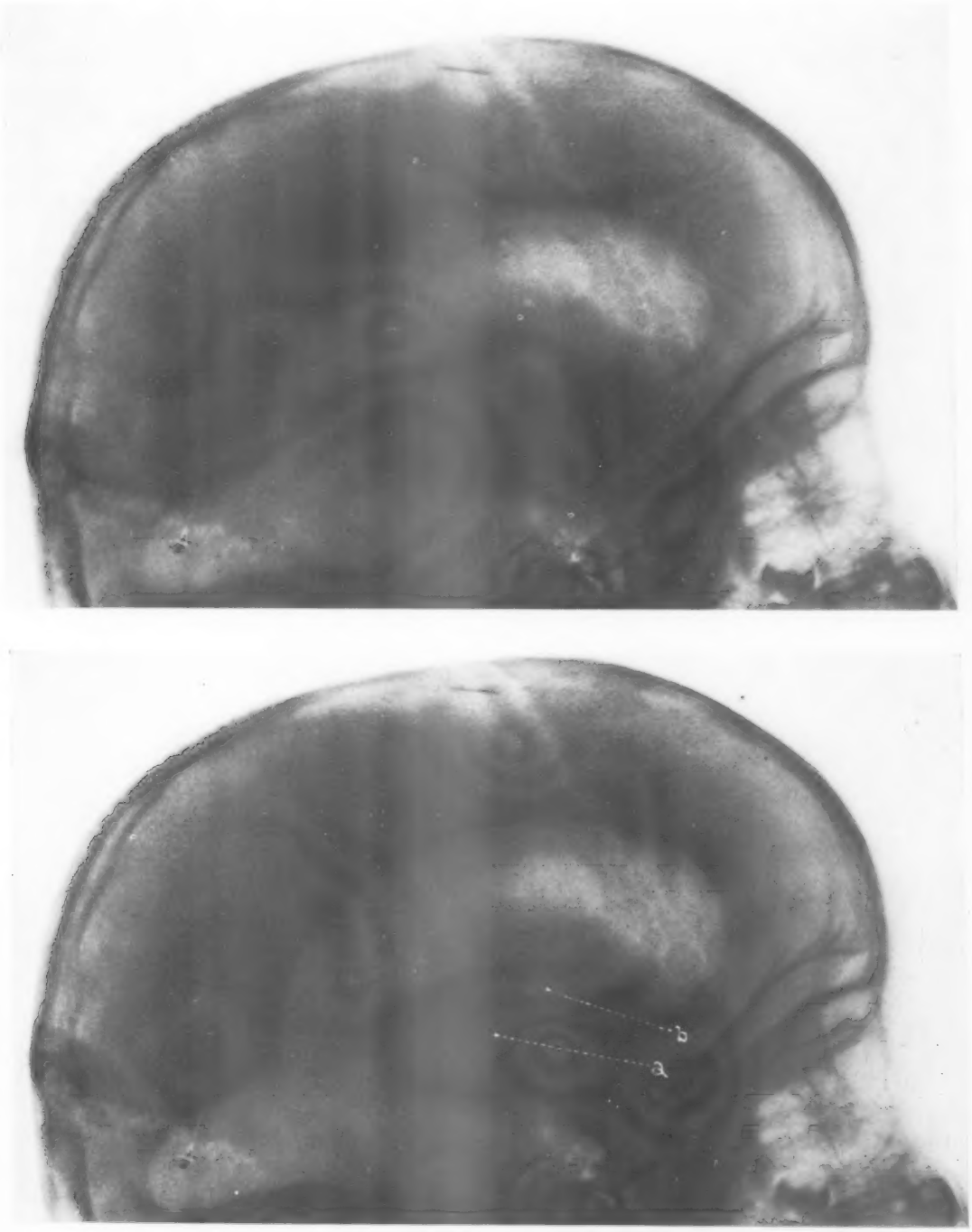

FIG. 3. Ventriculogram in a child three years old, with tuberculous meningitis. The ventricle is slightly dilated, an early obstructive hydrocephalus having resulted from closure of the foramina of Magendie and Luschka by exudate. The separation of the frontoparietal sutures also indicates intracranial pressure. (*a*) third ventricle: (*b*) probably the foramen of Monro. The body, the posterior horn, and the descending horn of the lateral ventricle are obvious.

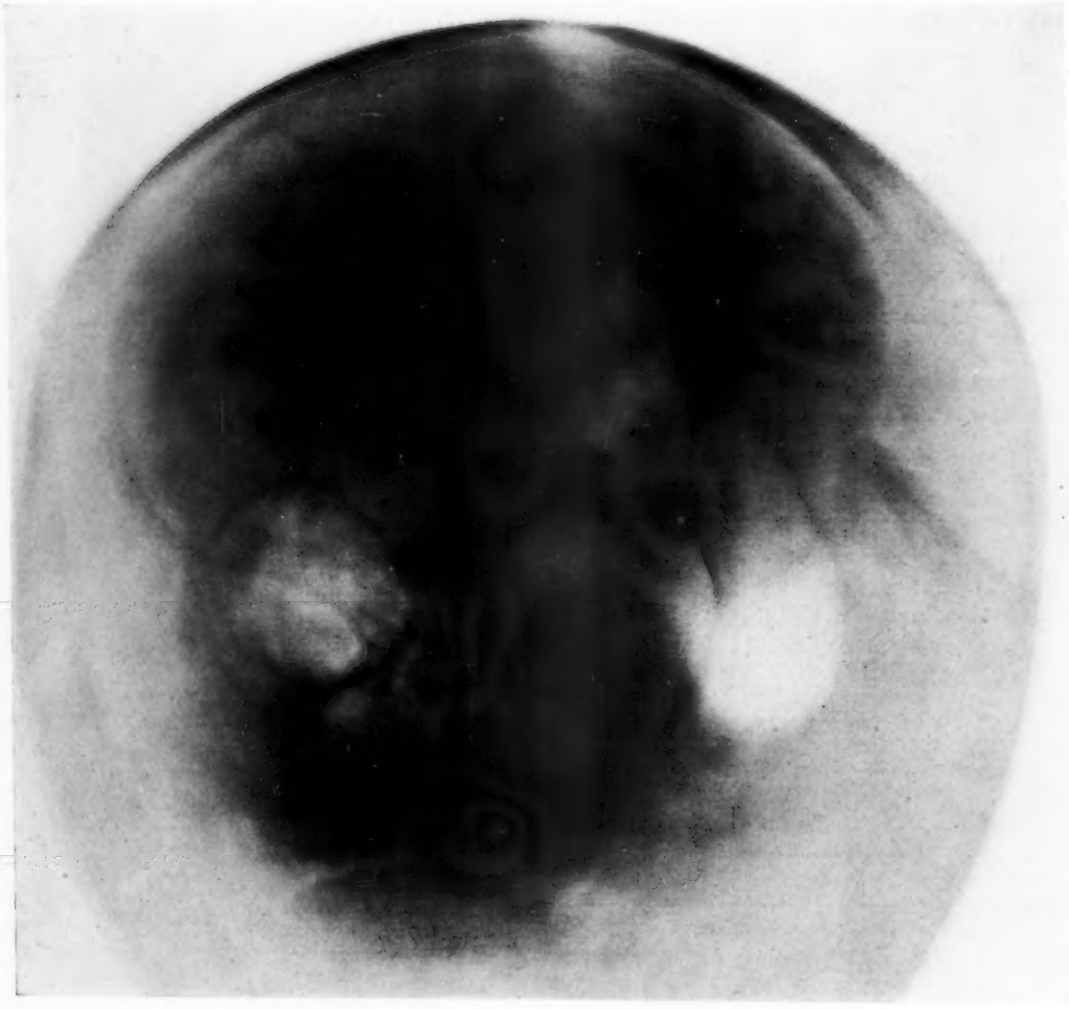

FIG. 4-A. Anteroposterior ventriculogram of Fig. 3. Note the unequal distribution of air on the two sides. The ventricle shadow is greatest in the body and descending horns, owing to the depth of the column of air. The posterior curved and ventrical part of the ventricle shows as a lighter shadow, communicating the two deeper shadows. The shadow is lighter because the smaller column of air gives relatively less penetration to the roentgen rays. The curvature of the ventricles and the perspective are brought out by stereoscopic vision. (*a*) third ventricle.

should be placed with the face down and partially rotated so that the ventricle to be aspirated is beneath and the needle enters at the most dependent point possible. This position permits the maximal drainage of fluid from the opposite lateral and the third ventricles. Aspiration through a puncture in the posterior or descending horn permits a fairly complete removal of the fluid from one ventricle and from that portion of the other lateral ventricle which is anterior to the foramen of Monro. In the aspiration of fluid from the posterior horn of the lateral ventricle, the patient must lie with the face directed upward and backward and the head rotated from 30 to 40 degrees toward the side of the needle.

The exchange of air for cerebrospinal fluid must be made accurately. If the air injected is greater in volume than the fluid withdrawn, acute pressure symptoms

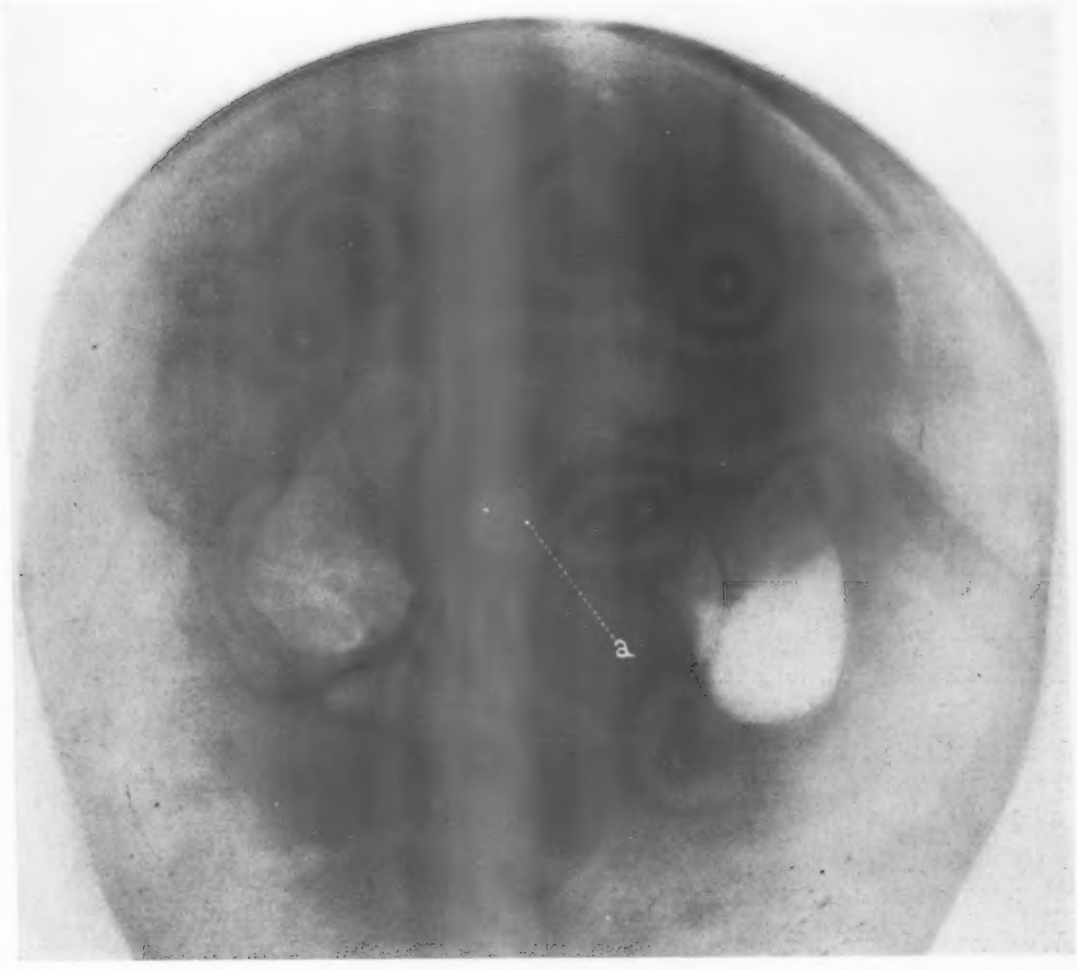

FIG. 4-B. (See description under 4-A.)

will result. To attain accuracy we have used a Record syringe with a two-way valve attachment (Fig. 1). A small amount of fluid (20 c.c.) is aspirated and an equal quantity of air injected. This is repeated until all the fluid has been removed. By aspirating and injecting in small quantities, injury to the brain from negative pressure is prevented. Not knowing the size of the ventricles beforehand, we have no way of estimating the amount of air necessary to fill one ventricle. For this reason we have preferred the removal of all the fluid that can be readily obtained. This has been found to be but little greater than the contents of one ventricle.

Needless to say, owing to the lighter weight of air, the ventriculogram represents the ventricle farthest from the roentgen-ray plate. To insure the best results the sagittal plane of the head should be parallel with the plate. Valuable assistance can also be obtained from anteroposterior roentgen-rays. The head should then be placed so that the sagittal plane is vertical, preferably with the occiput resting on the plate. With the latter precaution a more even distribution of air on the two sides is obtained and the ventriculogram represents the anterior portions of both lateral ventricles. For special points in diagnosis additional anteroposterior views may be

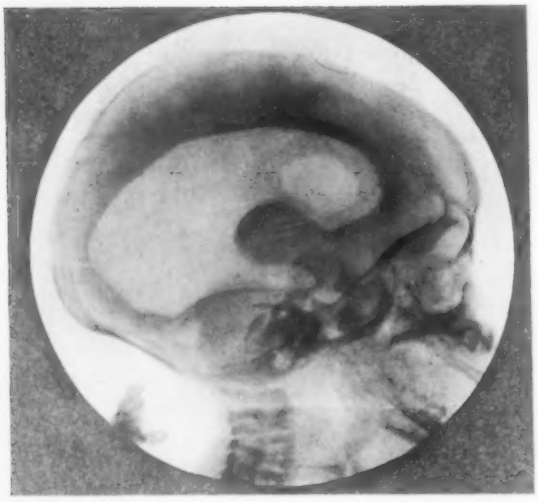

FIG. 5.

Ventriculogram of moderately distended ventricle in a case of communicating hydrocephalus. The size of the head is normal. Note the obliteration of the more normal ventricular contour shown in Fig. 3. The posterior horn is supplanted by a diffuse posterior bulging. The deeper shadow in the anterior part of the ventricle is due to air in the opposite ventricle.

taken of the posterior and descending horns of the ventricle by placing the forehead on the plate.

RESULTS FOLLOWING INJECTION

We have injected air into the cerebral ventricles at least twenty times. In some instances the injection has been repeated. The amount of air injected has varied from 40 to 300 c.c., the larger quantities in cases of internal hydrocephalus. Only once has there been any reaction, and in this case the injection (300 c.c.) was made 48 hours after the first stage of an operation for cerebellar tumor (Fig. 3.). The reaction was characterized by a rise of temperature, nausea, vomiting, and increased headache, all of which were quickly relieved after release of the air by a ventricular puncture. Ten days later, a large cerebellar tumor was removed, the patient making an uneventful recovery. All of the injections have been made in children varying from six months to 12 years of age. Invariably the lateral ventricle has been sharply outlined in the roentgenogram. In two instances the third ventricle and the foramen of Monro were visible (Figs. 3 and 8). In none, however, have we observed the fourth ventricle or the aqueduct of Sylvius. The practical value from pneumoventriculography is expected principally from the shadows of the lateral ventricles.

Day by day the air shadow diminishes

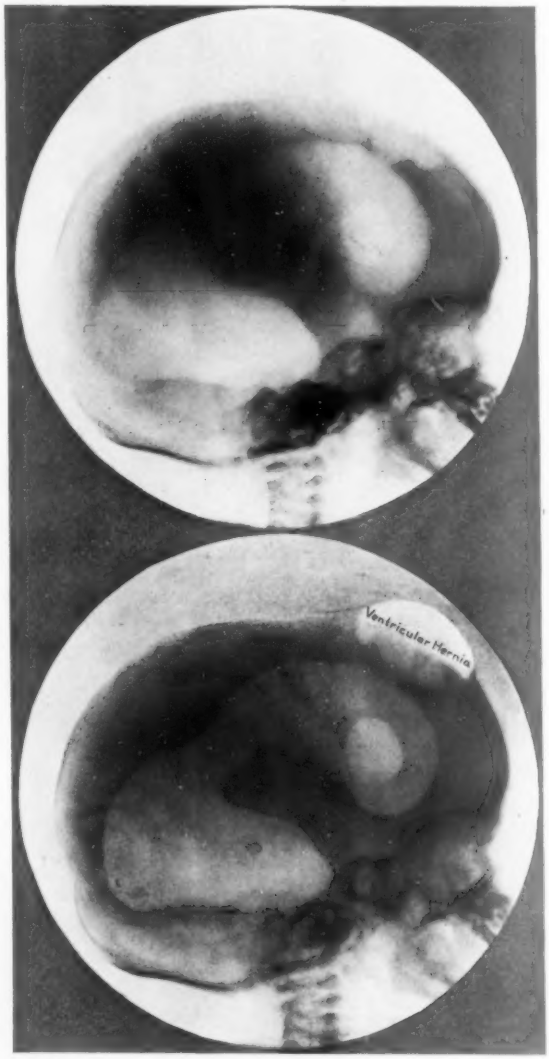

FIG. 6.

Ventriculogram (lateral view) of a more distended ventricle in a fairly advanced case of communicating internal hydrocephalus. Note the ventricular hernia and its neck communicating with the anterosuperior part of the lateral ventricle. It was necessary to draw the hernia in the lower picture because the roentgen-ray shadow of the hernia on the roentgen-ray plate was so slight as to be visible only by an oblique or reflected light. The constriction in the center of the ventricle is due to the fact that air does not fill the ventricle.

and eventually disappears. In a case of internal hydrocephalus it required two weeks. Possibly in more normal cases the time may be less, as air in other body tissues vanishes much more rapidly. In all probability absorption of air injected into the ventricles takes place by the same channels as in the case of the ventricular cerebrospinal fluid. In a previous communication[2] it has been shown that cerebrospinal fluid is almost entirely absorbed from the subarachnoid space; that only a very slight absorption takes place from the ventricles. Phenolsulphonephthalein in a closed ventricular system disappears in from ten to twelve days, whereas it is absorbed in from ten to twelve hours when the ventricles communicate with the subarachnoid space, where the absorption of cerebrospinal fluid normally takes place.

Air introduced into the ventricles acts in no way differently from the air included at every intracranial operation. Following tumor extirpation especially, the resulting defect fills with air which, unless displaced by salt solution, is shut in when the dura and scalp are sutured. For a few days pending its absorption from tumor defects the patient may be conscious of the movement of the air when the head is turned, but its presence is without any other effects.

THE VALUE OF VENTRICULOGRAPHY

Even in the few cases here reported ventriculography has proven of great practical value. For the first time we have a means of diagnosing internal hydrocephalus in the early stages. Internal hydrocephalus is one of the most insidious diseases of the brain and is rarely diagnosed before a considerable amount of cortical destruction has resulted. This is true of adults as well as of children. With exact visualization of the ventricles the findings are pathognomonic. Not only the existence of hydrocephalus but its degree and the amount of brain destruction are at once evident from the ventriculogram.

In one case (in an infant six months old) an internal hydrocephalus was suspected from a bulging fontanel, but the ventriculogram showed no enlargement of the ventricles. Another child (three years old) remained drowsy for several days after apparent recovery from an attack of epidemic cerebrospinal meningitis. The

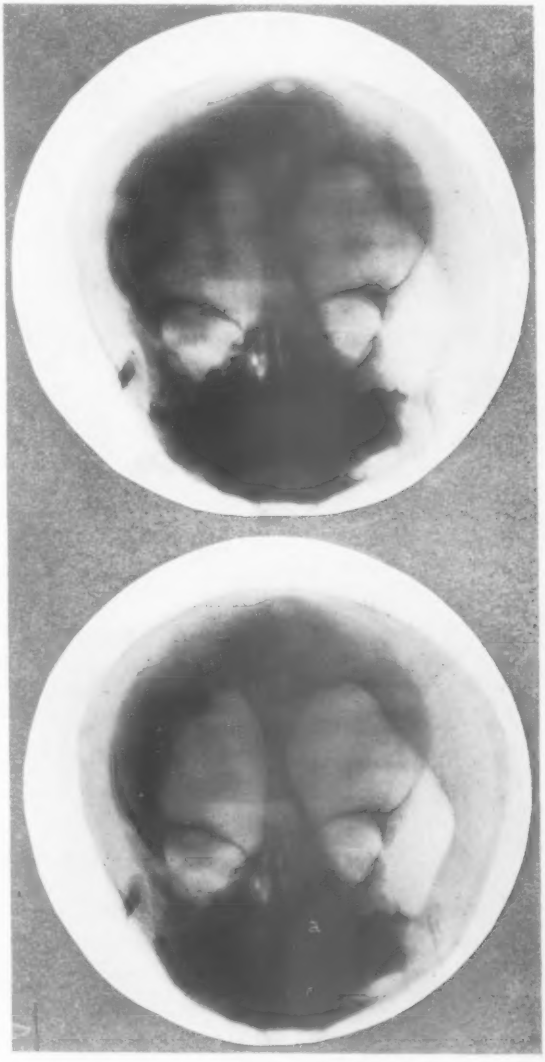

FIG. 7.

Anteroposterior view of Fig. 6. Note the fairly equal distribution of air in the two ventricles. This is probably due to the more extensive communication due to the enlarged foramina of Monro.

A = third ventricle.

[2] Dandy and Blackfan: *Am. J. Dis. Child.*, 1914, Vol. VIII, p. 406; 1917, Vol. XIV, p. 424. Also *J. Am. M. Assoc.*, 1913, Vol. LXI, p. 2216.

FIG. 8–A. Ventriculogram (lateral view) in a large head with closed sutures. The convolutional atrophy of the skull, indicative of internal hydrocephalus, is evident in the occipital and frontal regions. The markings are intensified by the air in the ventricles. III is third ventricle. The downward projection from the 3rd ventricle is probably the infundibulum. The patient was 12 years old; a large cerebellar tumor has been removed.

spinal fluid was clear and contained no organisms. The ventricular fluid was turbid and organisms were present; the ventriculogram demonstrated a greatly enlarged ventricle. The diagnosis of obstructive internal hydrocephalus, clinically unsuspected, was made with absolute certainty from the ventriculogram.

In two other children measurements of the head were normal but hydrocephalus was suspected because of abnormally large fontanels. In each case the ventriculogram demonstrated ventricles which nearly filled the cranial chamber (Fig. 5).

One of the most interesting diagnoses, made possible only through the ventriculogram, was in a colored child eight months old. The head was definitely larger than normal, indicating the probability of an internal hydrocephalus. Over the anterior fontanel, but slightly to one side, was a protruding tumor suggesting a meningocele, and this diagnosis had been made. Air injected into the lateral ventricle passed directly into the tumor. In the lateral ventriculogram the tumor was seen to arise from the greatly distended ventricle by a narrow neck (Fig. 6). An anteroposterior ventriculogram showed this communication to be unilateral. The diagnosis of a ruptured cortex with a (false) ventricular hernia was established, and subsequently verified at necropsy.

In another case a large cerebellar tumor

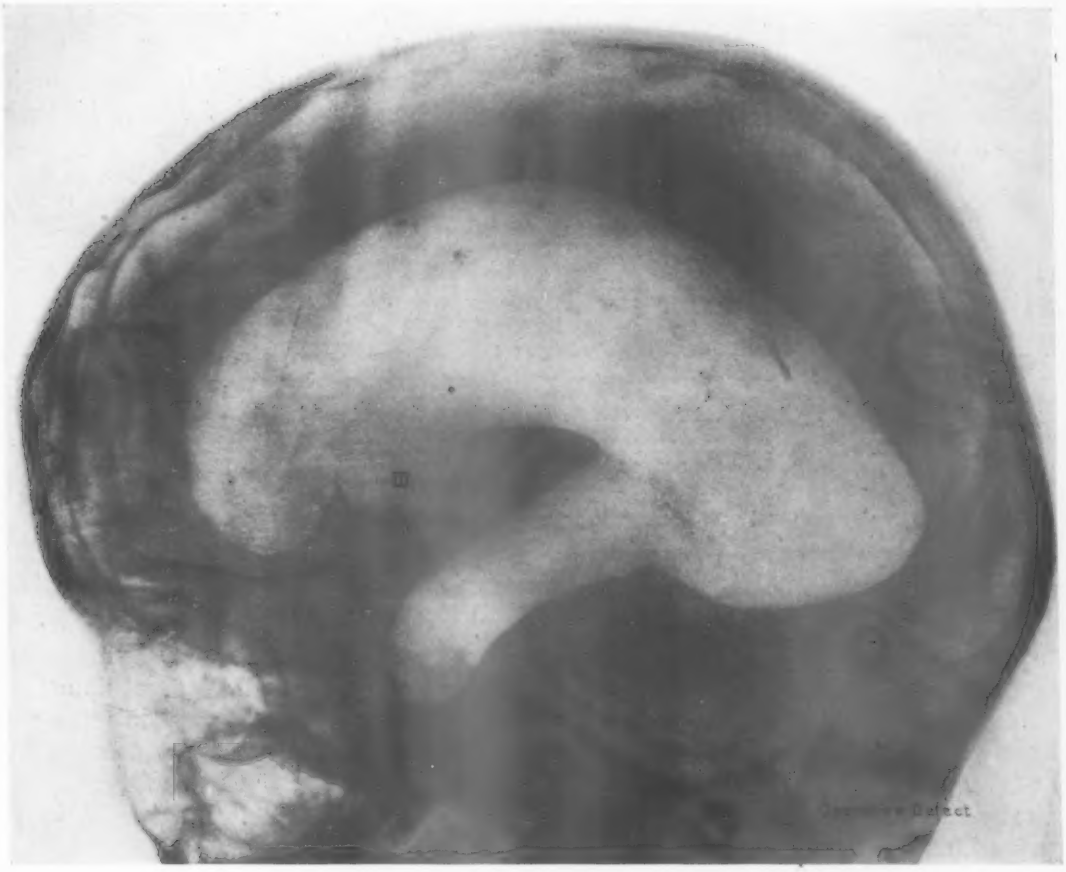

FIG. 8–B. (See description under 8–A.)

was removed from a boy 12 years old. The large head, the marked convolutional atrophy of the skull, blindness and the location of the tumor, made the diagnosis of internal hydrocephalus certain, but only the ventriculogram gave an accurate estimation of its advanced degree and the amount of brain destruction (Fig. 8).

Without a ventriculogram the diagnosis of internal hydrocephalus in children is frequently guess-work; with the ventriculogram the diagnosis is absolute.

We have as yet not obtained a normal ventriculogram. In one of these cases the ventricle was small, but not known to be normal. It is possible that one of the earliest signs of internal hydrocephalus may be alteration in the shape of the ventricle due to the pressure effects on parts of the wall which are least resistant. The obliteration of the angle between body and posterior horn in Fig. 5 (contrasted to Fig. 3) suggests this probability, but ventriculograms of the intervening stages and the normal are lacking.

We have not yet applied ventriculography to adults, but expect to do so in all cases in which the diagnosis is obscure. In a boy of 12 years the ventriculogram was even sharper than in younger children. In adults we should expect the ventriculogram to be at least as sharp, or possibly even more so because of the greater contrast between the density of air and bone. Several possibilities are anticipated from ventriculograms in adults: (1) The enlarged ventricles in internal hydrocephalus should be absolutely defined. (2) Tumors in either cerebral hemisphere may dislocate or compress the ventricle and in this way

localize the neoplasm. (3) Tumors growing into the ventricles may show a corresponding defect in the ventricular shadow. (4) A unilateral hydrocephalus may be demonstrable if the air cannot be made to enter the opposite ventricle.

CONCLUSIONS

1. The outlines of the lateral cerebral ventricles can be sharply outlined by the roentgen-ray if air is substituted for cerebrospinal fluid.

2. The injection of air into the ventricles has had no deleterious effects in twenty cases.

3. Ventriculography has already proved of great practical value in the diagnosis and localization of many intracranial conditions. It is invaluable in internal hydrocephalus.

AN IMPROVED DEVICE FOR THE ACCURATE LOCALIZATION OF FOREIGN BODIES BY MEANS OF THE ROENTGEN-RAY *†

BY S. C. BARROW, B.S., M.D.

SHREVEPORT, LA.

DURING the last few years so many devices for the localization of foreign bodies by means of the roentgen ray have appeared, and so many modifications of these, that it would appear there should be at least one among the many which would meet the essential requirements of mathematical and practical accuracy, simplicity and speed, as well as the great desideratum of mapping several points from which the surgeon may choose accurately his point of attack, instead of from the usual two points shown.

However, a careful study of these instruments as described in the publications I have seen, reveal to the practical roentgenologist that they fail to measure up to these essentials in full, particularly the one last mentioned.

The device illustrated in Fig. 1 and fully described below, is constructed on the parallax principle and under repeated rigid tests has proven absolutely accurate, rapid, simple and easy of manipulation.

DESCRIPTION OF APPARATUS

Referring to the illustration, we see that the localizer consists of the following parts: (a) hardwood base 8 by 12 inches by ¾-inch thick, through the center of which is a groove (f) which carries a sliding bar (e), in the right-hand end of which is a metal ring (y) which carries an ink pad; the upper surface of this bar is scaled to quarter inches (k), and the under surface is notched (l) which notches hold in any position placed.

On the left-hand end of the base (a) is a post (b) which is scaled to quarter inches and carries two sliding bars (c and d) which by double cuffs (gh and g′h′) permits horizontal and perpendicular movement; each bar on its upper surface is scaled to quarter inches.

On the right-hand end of bar (c) is a small cross bar, in the center of which is a metal ring (x) through which an indelible mark may be made; on the ends of this small bar are two other small rings (ww), each of which is one inch from center of ring (x); to the left of this bar is a sliding bar (w′w′) of same dimensions as bar (w w), the sliding cuff having an open center (z) through which the rays may pass.

Bar (d) has in its right-hand end a small metal ball (i); three bars (cde) are at all times in the same perpendicular plane.

* Read before The Texas Roentgen Ray Society, San Antonio, Texas, May, 1918. Reprinted from *Texas Medical Journal*, June, 1918.

† This article was first offered for publication in May, 1918. The editor was advised not to accept it on the ground that no further additions would be made to standard apparatus. Recently it was decided to add some of Dr. Barrow's suggestions to Blaine's apparatus. For this reason the article is published.

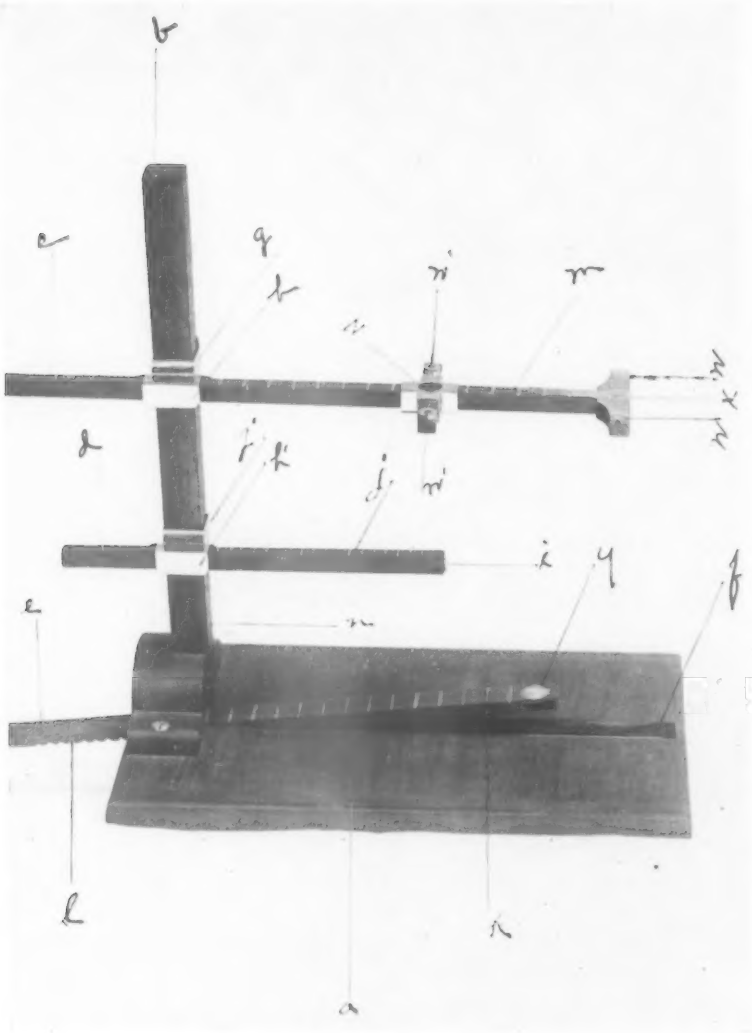

FIG. 1.

TECHNIC FOR USING THE LOCALIZER

In order to locate a foreign body it is necessary to have the usual horizontal roentgenoscope with sliding tube box and diaphragm. The patient is placed on the table and the localizer base (a) is slid beneath the patient and on top of the table, the bar (e) lying level in groove (f) while bar (w w) rests on upper surface of patient immediately beneath the fluorescing screen. The diaphragm being wide open and the room darkened, the tube is energized and foreign body in a general way located; the diaphragm is then closed down, allowing only a small beam of rays to pass, when the base of localizer and bars (c and e) are gently moved until the shadows of (y), (x) and foreign body are *accurately* superimposed. The diaphragm is then opened wide and the tube shifted so that the shadow of foreign body moves into that of (w) or (w); bar (d) is then pushed in until it touches the skin surface, and cross-bar (w′w′) likewise until shadow of (i) falls in shadow of circle (z); this accomplished, bar (d) is then raised or lowered until shadow of (i) moves into shadow (w′) in the same direction that shadow of foreign body was made to shift.

The lights are then turned on, screen removed, an indelible mark made at (i) and (x), while gentle pressure on left-hand end of (e) causes the ink pad at (y) to register its location, all of which can be accomplished without changing position of patient, which would endanger an accurate marking.

It is then only necessary to refer to the scales (m, n and k) to determine the distance of the foreign body below (x), above (y) and horizontally in from (i).

We thus see that we have made at once a localization which will enable the surgeon to remove the foreign body by any one of these three routes he may choose.

In addition to accuracy, simplicity and speed, this device carries with it the distinctive feature of giving three points of localization, all of which may be indelibly marked without changing position of patient from that in which he was at the moment of determining these points, thus eliminating a common source of error.

The model as illustrated, and with which we have carried out all our experiments, is constructed of hardwood in the main; aluminum may be substituted in its construction excepting for the base (a), which would be too thick if provision for groove (f) were made.

AEROPLANE SURGICAL UNIT

As mentioned in the Paris Letter, page 1155, a flying surgical unit has been devised by Nemirovsky and Tilmant. The specifications were filed with the Ministère des Inventions, Feb. 21, 1918. The success of the aeroplanes devised to carry the wounded to the surgeon soon suggested the advantages of conveying the surgeon to the wounded, and this "aerochir" is the result. It aims to bring to the first aid stations, to advanced posts without roentgen equipment, a well equipped surgical and roentgen outfit, and aid advanced posts overwhelmed by the influx of wounded beyond what they had been organized for.

The aerochir is designed to carry, beside the pilot, a surgeon and a roentgenologist to serve as assistant to the surgeon, with all the roentgen and surgical material for all kinds of interventions. The motor of the plane can supply the power for the roentgen current with the interposition of a small transformer and interrupter. It can serve also for electric sterilization, or a storage battery can be utilized for this. The apparatus are light and portable so that they can be readily carried into a first aid post or other surgical station and set to work at once, or they can be used in connection with the aerochir itself. The apparatus are not described in detail, but the advantages of a flying radiosurgical unit, alone or in squadrons, are emphasized, especially the rapidity with which surgical aid can be brought, the fact that the roads are left free just at the time when they are liable to be most clogged, the speed of transit and the fact that the wounded is spared the transportation, having aid brought to him in the swiftest and most complete manner. In urgent periods the aeroplane could return to headquarters for a new outfit, so that one or two of these aerochirs could serve for 200 kilometers of the fighting front, and no spot would be more than two hours away when summoned by telephone. The radioscopic and radiologic manipulations not requiring the patient to be undressed could be done in the aeroplane itself. With the cap devised by Dr. Mondain to be used with Nemirovsky's compass, the projectiles can be located in full daylight. This compass as well as any surgical instrument needed can be placed in the aeroplane without cumbering it.—*Jour. Am. M. Ass.*, Nov., 1918. "Current Medical Literature."

THE PRACTICAL USE OF THE WHEATSTONE STEREOSCOPE

BY H. CLYDE SNOOK, A.M., M.S.

NEW YORK

THE Wheatstone Stereoscope consists essentially of three things: a pair of view boxes to illuminate the stereoscopic pair of plates; a pair of mirrors mounted at right angles to each other for viewing the plates; and an optical bench, or a support, for the mirrors and the view boxes, on which they may be adjusted in mechanical relation with respect to each other. Stereoscopic vision is obtained by the right eye of the observer seeing one plate alone and the left eye of the observer seeing the other plate alone, and having the lines of vision converge from the eyes of the observer toward a point back of the mirrors where the two virtual images of the two plates occupy practically identical positions so that they may blend and repeat for the observer the conditions of ordinary normal vision of a similar real object. The brain makes out of these two virtual images a product which results in stereoscopic or normal vision of a solid object if the other necessary conditions regarding the making of the plates and the placing of them in the stereoscope are fulfilled. (See Fig. 1.)

In order that the observer may see the object on the plates, it is obvious that the relation of the eyes of the observer to the plates must be such that the field of vision is confined to the plates and that the plates include all portions of the object to be viewed. (See Figs. 2 and 3.) Since the distance between the centers of the pupils of the eyes of the average individual is two and one-half inches, it is obvious that a symmetrical position of the eyes, with respect to the plate, requires that each eye should lie in a vertical plane which passes through the center of the plate and that each eye should be one and one-fourth inches away from a perpendicular passing through the center of the plate.

In order that the *x*-ray tube may see the object as we wish the eyes of the observer to see it, we must arrange two positions of the focus spot of the *x*-ray tube in exactly the same relation to the plate as that sustained by the eyes of the observer. (See Fig. 4.) This gives us a distance of two and one-half inches between the two positions of the focus spot of the

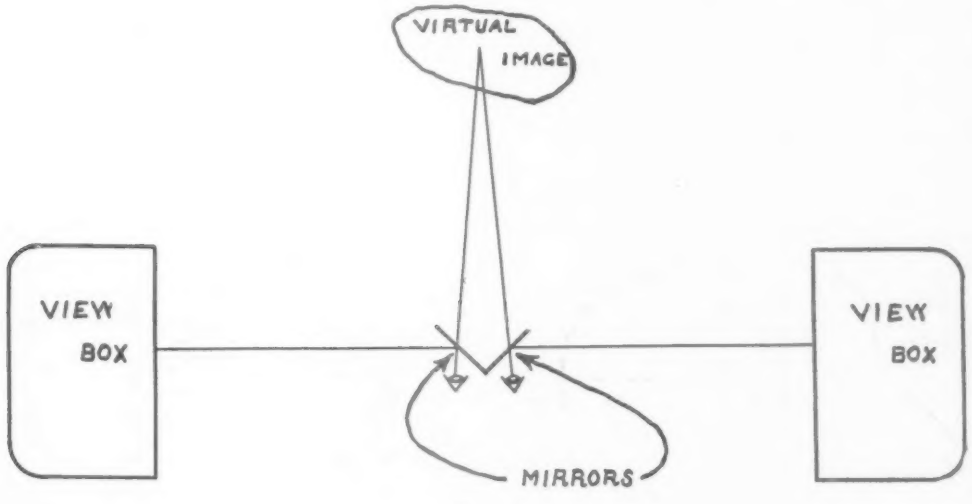

FIG. 1.

tube; that is to say, between the two exposures which must be made, we must have a straight line distance of two and one-half inches. *It makes no difference* whether we move the *x*-ray tube in an arc of a circle, in a straight line, or in any other curve which we may desire to use to accommodate the mechanism of our *x*-ray tube holder, *so long as the final result is a horizontal distance of two and one-half inches between the two positions of the focus spots at the times of the two exposures.*

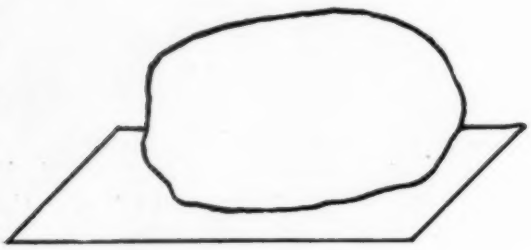

FIG. 2.

The perpendicular points let fall upon the plate from the focus spots are called the "foot points," being the feet of the perpendicular lines drawn from the focus spots to the plate. These "foot points" are the important things with respect to the identity of the plates of the stereoscopic pair. In order to obtain the maximum benefit of the field of vision it is still obvious that the focus spots should be symmetrically placed about the center of the plate with a distance of one and one-fourth inches from each of the focus spots to the perpendicular let fall upon the center of the plate.

Since we must have two plates in the stereoscopic pair—one for the right eye

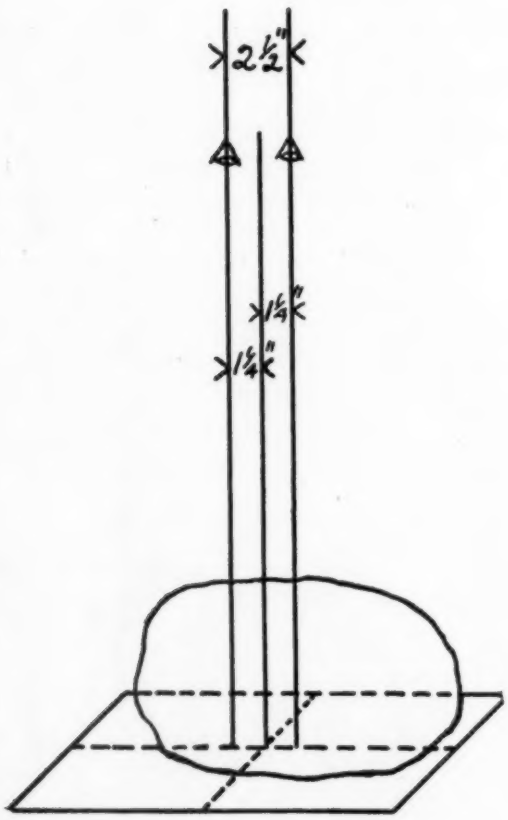

FIG. 3.

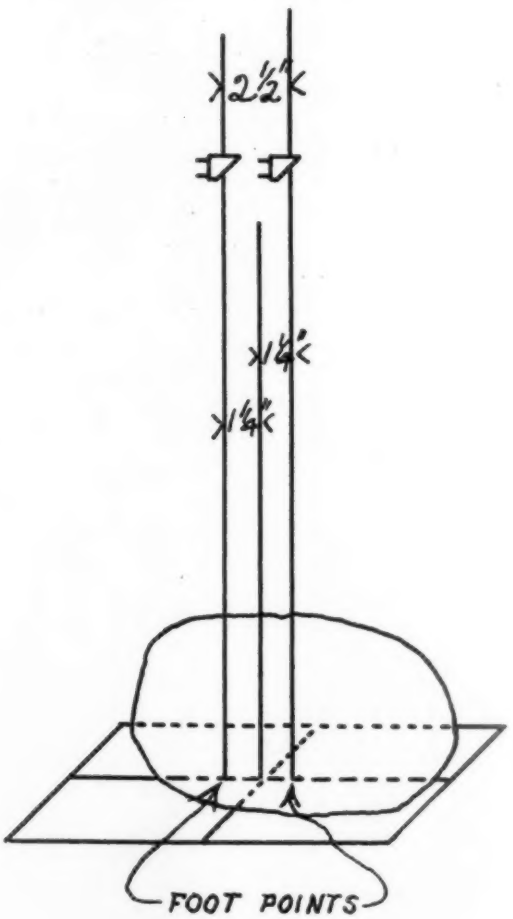

FIG. 4.

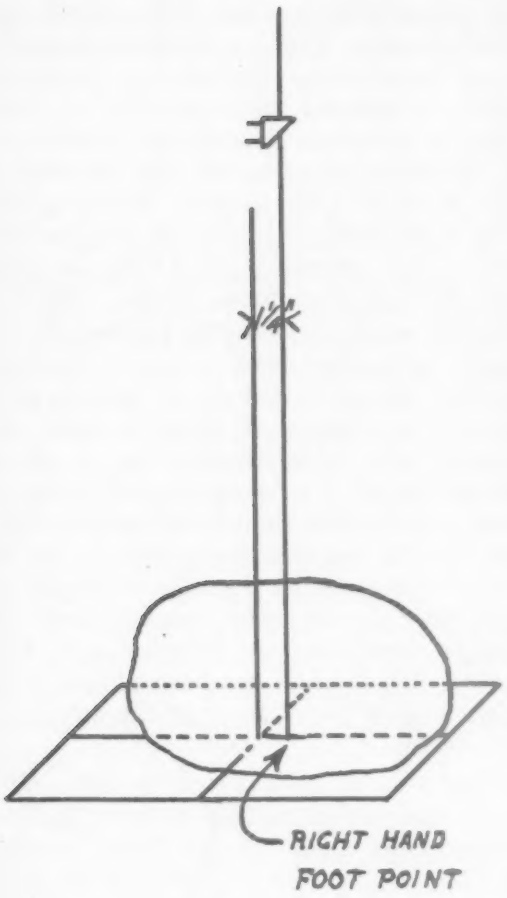

FIG. 5.

to see and the other for the left eye to see—we will have one plate with a right-hand foot point (see Fig. 5), and we will have another plate with a left-hand foot point. (See Fig. 6.)

Images of the object upon the plates do not ordinarily reveal the position nor the identity of either the right-hand foot point or the left-hand foot point; we therefore must devise a method whereby these foot points may be distinguished. (See Figs. 7 and 8. A slight shifting of entire image to right and left is the only difference usually distinguishable.)

In the diagram No. 9, let us assume that an object A-B capable of casting a shadow rests upon the photographic plate in a perpendicular position. It is seen that the rays, radiating from the focus spot upon the plate, will cast a shadow B-C of this vertical object A-B. Since all the points in the line B-C are necessarily in line with both the focus spot and the points along the line A-B, and since A-B being perpendicular must be parallel to a perpendicular let fall upon the plate from the focus spot, the shadow B-C must point towards the foot point. It is seen from these conditions that it makes no difference where on the photographic plate we may place the vertical object A-B, its shadow B-C, if prolonged, will pass through the foot point in every instance. (See Fig. 10 for another position of A-B.) Since the prolongation of B-C passes through the foot point, from one shadow alone we merely know that the foot point itself lies somewhere in the prolongation of the shadow B-C.

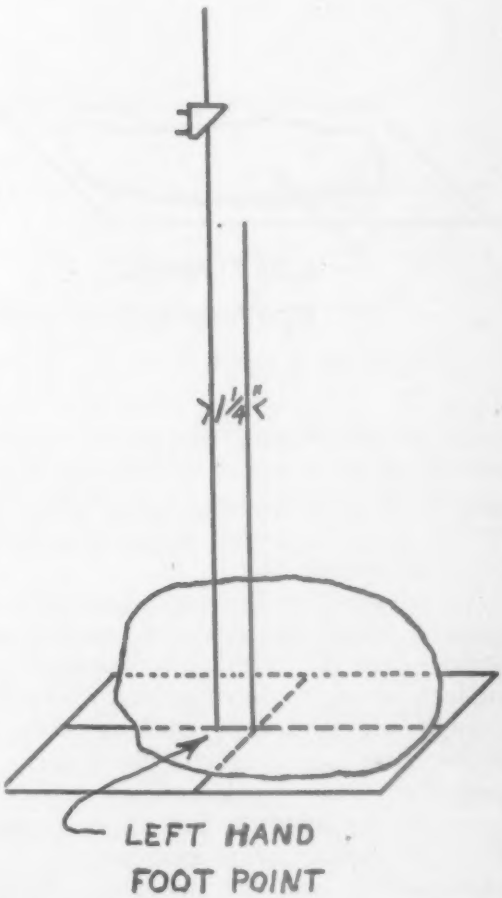

FIG. 6.

Should we have two vertical objects and should we produce their *x*-ray images and then draw their prolongations upon the finished *x*-ray plate, we would find the foot point at the intersection of these two prolongations since the foot point lies in each of them and can lie only at their common point—their intersection. (See Fig. 11.)

It is an easy matter,' having obtained these two diagonal shadows of the two

FIG. 7.

FIG. 8.

vertical objects with a lead pencil, to draw their prolongations upon the dried emulsion of the photographic plate and find their intersection—the location of the foot point. (See Figs. 12 and 13.)

A convenient method for obtaining these diagonal shadows is to use two small wood blocks—each of them approximately a one-inch cube, to have driven vertically through the center of each of them a slender iron nail—and to place each of these two little blocks on an adjacent corner of the area on the upper surface of the tunnel or plate changer, so that their shadows will fall upon the corners of the plate where they will not greatly interfere with the area of the object under examination. This is a very simple method and requires no complicated apparatus. (Fig 13 locates a right-hand foot point and Fig. 14 locates a left-hand foot point.)

A still simpler method is to use only one wood block with its nail driven perpendicularly through it. This is feasible since it is not necessary to know the exact position of the foot points. *What we merely wish to know is whether the foot point is a right-hand or a left-hand foot point.* An examination of actual plates with the images of these vertical iron nails, or a little thought given to the geometry of the shadows, will convince any one that the shadow of the nail on the plate with the right-hand foot point will be shorter or longer than the shadow of the nail on the plate with the left-hand foot point, depending on whether the wood block with the nail has been placed at the right end of the plate or at the left end of the plate.

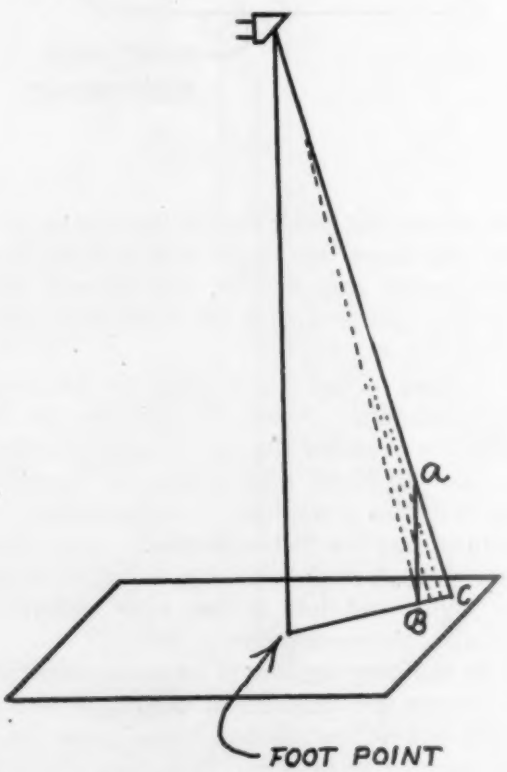

FIG. 9.

If the operator forms the habit of right-handedness and places the wood block with its nail at the right end of the plate in the lower right-hand corner, he can dispense with the second wood block with its nail. Of course, if he forms the habit of left-handedness and follows through a similar reasoning he can dispense with the second wood block in a converse manner. However, with the wood block and its nail at the right end of the plate, conveniently in the lower right-hand corner, the shadow of the nail on the plate with the right-hand foot point will be shorter than the shadow of the nail on the plate with the left-hand foot point. (See Fig. 15.) This can be remembered very conveniently. A short shadow indicating a foot point near to the shadow, is a right-hand foot point. The other plate, having a longer shadow, has its foot point farther away from the shadow of the nail—it is farther away toward the left—and is, therefore, a left-hand foot point. (See Fig. 16.)

The determination then as to whether the foot point is a right- or left-hand one resolves itself simply into determining which of the two shadows of the nails is the longer; this is a very simple thing.

The optical conditions for correct stereoscopic vision include the necessity of the right eye looking at an image with a right-hand foot point and looking at this image with the right-hand foot point in the correct right-hand position with respect to the right eye. Conversely, the left eye of the observer should look down upon an image with a left-hand foot point.

It is well known that the virtual image seen in a mirror is reversed horizontally with respect to the real object itself so that it is a right-hand-left-hand reversal which one sees in a mirror. That is to say, the plate of a chest would have the heart on the right side of the patient as one sees the plate in a mirror instead of with the heart on the left as it is in the living subject. Also, if in the ordinary way we look in a mirror at a plate of a patient's right hand, the image seen in the mirror would appear to be the patient's left hand. Therefore, since the mirrors in the stereoscope give us a right-hand-left-hand reversal of the plates under examination we must put the plates in the view boxes in such a position that the observer will look down upon a right-hand foot point

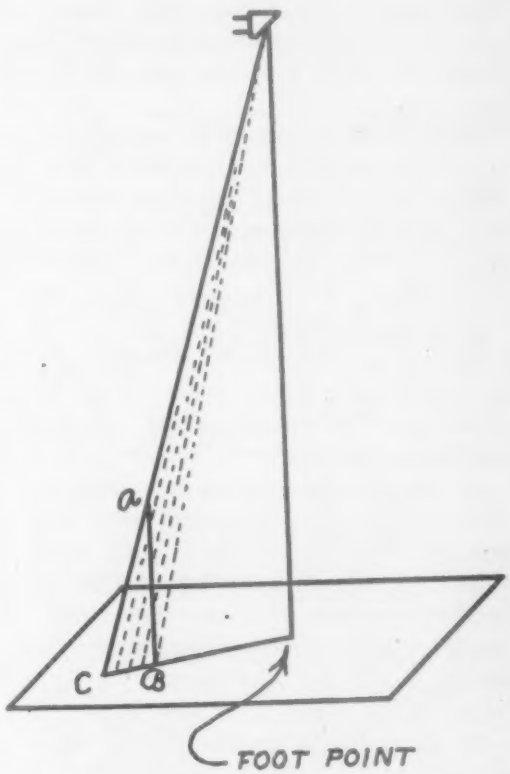

FIG. 10.

with the right eye and will look down upon a left-hand foot point with the left eye.

When the plates are right side up, that is to say with the patient standing on his feet and not upon his head, there is only one position of the plates which is correct that does not give either one or both of these two errors; the one error is a right-hand-left-hand reversal of the patient, putting the heart on the patient's right side, making a left hand out of a patient's right hand, making a left kidney out of a right kidney, or a left knee out of a right

knee, etc.; the other error is a distortion of all of the object excepting that portion in direct contact with the *x*-ray plate, so distorted that in some cases the size of the parts is enlarged fifty per cent. beyond normal and at an angle of forty-five degrees from their true position, such as with the clavicle bone inserted between the first and second ribs, with one frontal sinus twenty-five per cent. larger than the other, or one lobe of the lung all distorted, etc.

This one correct way of viewing the plates right side up requires that they should be placed in the view boxes of the Wheatstone Stereoscope with their glass sides "out," with the "foot points" towards the back of the stereoscope, with the "eye-plate distance" the same as the "focal-plate distance," and with the lines of movement of the *x*-ray tube between exposures on each plate horizontally parallel to each other.

If we should put the plates in the stereoscope right side up, with the foot points toward the back and with the emulsion side out, we would have a left-handed patient but no distortion. The image would suffer a right-hand-left-hand reversal and the view would be from the front as the *x*-ray tube saw it.

If, however, with the plates right side up we should put the foot points to the front of the stereoscope with the glass sides out, we would have a distorted view of the object from below; the top would be enlarged from twenty-five to fifty per cent., and there would be a right-hand-left-hand reversal of the patient as viewed from below or behind. If we should put the plates in the stereoscope right side up with the foot points to the front and with the emulsion side out, we would have a distorted view of the patient from below or from the back with the front of the patient enlarged twenty-five to fifty per cent., but there would be no right-hand-left-hand reversal of the patient as viewed from below or from the back.

If, now, we should put the plates in the view boxes upside down, with the foot points toward the back and the glass sides out, we would have a correct front view of the object or the patient with no distortion nor right-hand-left-hand reversal—the patient would simply be upside down. Should we place the plates in the view boxes upside down with the foot points toward the back and the emulsion sides out, we would obtain a front view of the patient upside down with no distortion but with a right-hand-left-hand reversal. Should we put the plates in the stereoscope upside down with the foot points to the front and the glass sides out, not only would the patient be upside down but we would have a distorted view of the patient from below or behind, and with a right-hand-left-hand reversal. If the plates be put in the view boxes upside down with the foot points to the front and the emulsion side out, the patient would be upside down; there would be a distorted view or an

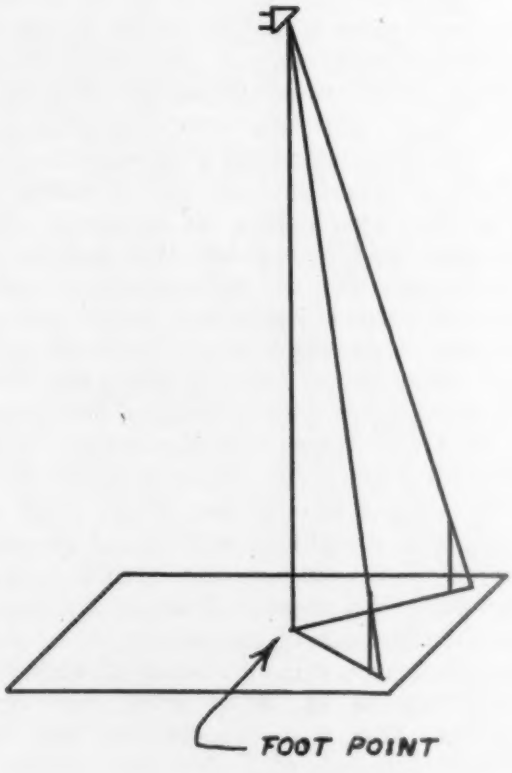

FIG. 11.

enlargement of the anterior portions of the object of twenty-five to fifty per cent.; we would be viewing the patient from below or from behind; but there would be no right-hand-left-hand reversal as viewed from below or behind. These results may be verified easily by making suitable stereoscopic roentgenograms of wood cubes.

It is thus seen that there are exactly eight ways of placing the stereoscopic pair of plates in the stereoscope; only two of them may be said to be correct without either distortion or reversals; and only one of the two gives a correct view of the patient right side up. To repeat, *the conditions of correct vision for the patient right side up require that the two plates be placed*

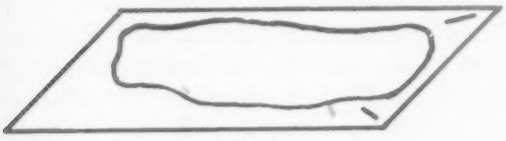

FIG. 12.

FIG. 13.

in the view boxes of the Wheatstone Stereoscope with their glass sides "out," with the "foot points" towards the back of the stereoscope, with the "eye-plate distance" the same as the "focal-plate distance," and with the lines of movement of the x-ray tube between exposures on each plate horizontally parallel to each other.

This one correct way of viewing the plates is not only the one correct way but also the easiest way to view the plates. The distortion produced by some of the other ways of viewing them causes a distinct eye strain and in many cases prevents the unaccustomed observer from getting any satisfactory stereoscopic vision at all. The other incorrect ways of viewing the plates which do not give distortion or eye strain give the obviously misleading views having right-hand-left-hand reversal leading to difficulties and errors in interpretation.

It should be noted that whenever the eye-plate distance is greater than the focal-plate distance the apparent thickness or height of the object looked down upon by the observer is greater than normal; conversely, if the eye-plate distance is less

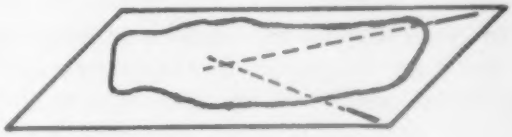

FIG. 14.

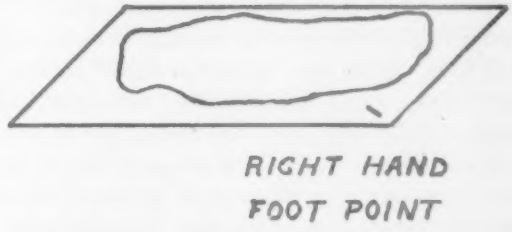

FIG. 15.

FIG. 16.

than the focal-plate distance the apparent thickness is less than normal. These errors in thickness either as to apparent increase or decrease of thickness may amount to an error of as much as fifty per cent. in some cases. If the eyes of the observer opposing the mirrors be higher in position than their obviously correct position opposite the mirrors in line with the foot points, the image of the object will be bent up from its true position; conversely, if the eyes are lower down than their correct

position in line opposite to the foot points, the image will be bent downwards. The observer can easily demonstrate to himself the error introduced by incorrect position of the eyes by moving the head in circular motion—the circular motion in a vertical plane in front of the mirrors of the stereoscope—and he will immediately observe that the top of the object is following the movements of his head, bending towards the observer's head at all times.

In order to put the lines of movement of the *x*-ray tube between exposures in a horizontal position in the stereoscope, and in order to put the eyes of the observer opposite the virtual images of the foot points, there are three adjustments which are desirable. The first adjustment is the movement of the mirror carriage back and forth away from and towards the observer. This adjustment causes the two virtual images of the plates to move bodily to the right or to the left with respect to each other, enabling the observer to superimpose the one upon the other with respect to this horizontal adjustment. The second adjustment is the raising or lowering of the plates in the view boxes, the raising or lowering of the view boxes themselves, or the rotation of the observer's head in a vertical plane, raising or lowering the one eye with respect to the other. This adjustment moves the two virtual images vertically with respect to each other, permitting the observer to superimpose the one upon the other with respect to this vertical movement. The third adjustment is the tilting of the mirror carriage in a vertical plane at right angles to the line of the optical bench, or the rotating of the plates in a vertical plane in the view boxes. This adjustment enables the observer to rotate the two virtual images simultaneously about their own centers so as to obtain superimposition of this kind.

Occasionally, there is difficulty in observation due to the double images caused by the thickness of the glass in the mirrors. When this is troublesome the only recourse open to the observer is to train himself to direct his attention upon and concentrate his observation upon the desired image. There is no method of observation ena-

Position of Plates on Stereoscope.			Resulting Stereoscopic View.							
			Right Side Up	Front	Undistorted	No Right-Hand-Left-Hand Reversal	Up-side Down	Back	Distorted	R-Hand-L-Hand Reversal
Right Side Up	Foot Points Back	Glass Side Out	x	x	x	x				
		Emulsion Side Out	x	x	x					x
	Foot Points Front	Glass Side Out	x					x	x	x
		Emulsion Side Out	x			x		x	x	
Up Side Down	Foot Points Back	Glass Side Out		x	x	x	x			
		Emulsion Side Out		x	x		x			x
	Foot Points Front	Glass Side Out					x	x	x	x
		Emulsion Side Out				x	x	x	x	

bling one to overcome this difficulty. It is inherent in the design.

If one eye of the observer is somewhat less acute or weaker than the other, sometimes a change in the intensity of the illumination of the one view box as compared with the other will be of help, enabling the weaker eye to obtain a stronger image.

It is obvious that one should strive for plates of uniform density. This requires that the exposures be as nearly identical as possible, and that the plates should be developed, fixed, and dried together—that is, they should go into the developer simultaneously, come out of it simultaneously, and go through the whole photographic process subjected to identical conditions.

Another practical point often neglected is the desirability of cleaning off from the glass or the back side of the plates, the dissolved gelatin which has dried upon the glass. This can be accomplished quite readily by rubbing these spots with a damp towel. The towel should be merely damp and not dripping wet, as there is danger of getting drops of water on the emulsion side of the plate. Since there is decided loss in detail due to secondary radiation from the object itself and from the parallax or enlargement of the portions of the object nearest the *x*-ray tube, it is necessary that absolute fixation of the parts should be obtained so as to prevent further loss of detail. Movement of the parts between exposures will result in an incorrect stereoscopic view. Movement during an exposure causes loss of detail in that one exposure, and loss of stereoscopic detail.

In making stereoscopic pairs one should have the focus-plate distance as great as is practicable to get good plates, because stereoscopic vision is best and detail is clearest under these conditions.

It is often of help to make a mixture of barium sulphate with tincture of green soap, to spread it upon a gauze bandage just as thinly as possible (so as to have the structure of the gauze stand out in detail on the plate), and to wind this smeared bandage around the part. This will give a stereoscopic outline of the skin. Where the skin itself is full of detail, such as the palm of the hand, the mixture of barium sulphate and soap may simply be smeared on the skin itself. To localize an orifice or a lesion, it is sometimes desirable to use a small strip or cross of tinfoil held in place with adhesive plaster.

In conclusion, it is emphasized that many men are failing to obtain satisfaction in their stereoscopic work because of the uncomfortable and unsatisfactory vision which they obtain due to incorrect procedure at some point in the series of steps necessary to obtain correct stereoscopic vision. It is hoped that the simple methods here described will be of assistance in making this work more comfortable and satisfactory.

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THE BARDEEN METHOD OF ESTIMATING HEART VOLUME

Size is the fundamental factor in the roentgen examination of the heart. The clinical method is to define heart borders by percussion and to locate the apex beat by palpation. The roentgen method of outlining the heart and locating the apex is incontestably superior. The result by either method leaves much to the judgment of the examiner as to whether or not the heart in question is enlarged, considering the size, sex and condition of the patient. No tables are to be found in works on diagnosis which give us the normal heart volume for height, weight, age and sex. This is doubtless because there existed previously no method of precision for estimating cardiac size.

Now, however, we have in the Bardeen[1] method an accurate means of estimating heart volume and heart weight for either sex from infancy to old age. Bardeen's papers on this subject are models of scientific method. The first publication is to be found in THE AMERICAN JOURNAL OF ROENTGENOLOGY, December, 1917. The second article appeared in the *American Journal of Anatomy*, March, 1918. It is in this second paper that full details are given of his investigations, experiments and deductions. Much of the work was done in the postmortem room, but the volume of roentgen-ray work in the living is ample and his roentgen-ray technic is beyond criticism. A full consideration of the literature of the subject is included. Bardeen's researches have provided us with tables of normal values whereby our findings in any particular case may be compared.

Briefly, the method consists in estimating the square area of the parallel-ray silhouette of the heart upon the roentgen-ray plate. The square area is found by means of the planimeter—an engineering instrument which automatically computes any area, however irregular, by simply carrying the pointer around the outline. In the case of the heart the outline on the plate must be completed from left to right auricle and again from apex across the upper border of the liver to the right auricle. Bardeen's postmortem studies, in which he has shown great ingenuity, demonstrate that this can be done with a very

[1] This table will be found on pages 414-415-416 of the U. S. Army X-Ray Manual. A reprint will be sent on application to the publisher of THE AMERICAN JOURNAL OF ROENTGENOLOGY.

small margin of error. This is the only part of the Bardeen method where the personal equation is ineradicable.

The parallel-ray silhouette is obtained by a teteoroentgenogram taken at a distance of two meters. The patient sits with the front of his chest against the plate which is inclined to 20 degrees. Six per cent. is then subtracted from the square area to make the correction necessitated by the divergence of the roentgen-rays. The result is a figure ready for comparison with the tables. The volume and weight of the heart in diastole is thus found in its relation to the normal.

Bardeen's studies regarding the variations of heart volume in different positions of the body are of no less value to the clinician than to the roentgenologist. Roentgen-ray methods here as elsewhere are exacting a precision in purely clinical findings that was not attempted in pre-roentgen days. In the supine position of the body the heart is shown to be from 10 to 20 per cent. larger than in the standing. This change is due in part to changes in hydrostatic pressure in the inferior vena cava. Restricting venous capacity for storehousing blood by bandaging the legs materially reduces the difference. Bardeen selects the sitting posture for heart-size determinations because physiologic variations are minimized,and for the same reason clinicians should use the same position.

Bardeen took the heart in systole and diastole and studied the variations in size during inspiration and expiration. He selects full but not forced inspiration and a time exposure of not less than one and one-half seconds to ensure the diastolic silhouette.

Bardeen's work is a contribution of permanent value to medical literature and gives an added luster to American roentgenology. It marks a forward step in clinical methods. Henceforth the planimeter is a necessary part of a roentgenological equipment and the Bardeen tables are indispensable additions to the diagnostics of the heart. A. W. C.

The Dangers from Roentgen Therapy in Exophthalmic Goitre

Our attention has been called to an abstract, appearing in the December 7, 1918, issue of the *Journal of the American Medical Association*, (159) of a report by Secher (*Ugeskrift for Laeger*, Copenhagen, Oct. 10, 1918, Vol. 80, No. 41) of a death following the roentgen treatment of a case of exophthalmic goitre. He quotes Belot and Simon, among others, as stating that a correctly given course of roentgen treatment is free from danger, but takes issue with their statements. While roentgenologists who have had much experience in the treatment of this condition will agree that it is by no means free from danger, especially in careless and inexperienced hands, they can certainly lay claim to the fact that the danger in the hands of men of experience is far less than the surgical risks. The tone of this abstract and the conclusions of the author loudly proclaim lack of knowledge of the physiological action of roentgen rays, especially as applied to the treatment of exophthalmic goitre. It is doubtless true that the majority of internists and surgeons do not understand the basic principles of roentgenotherapy in any conditions, to say nothing of its action in this particular one. The author cites several cases in which an ordinary goitre has become transformed into the exophthalmic type under roentgen treatment. Now, it is a well-known fact among roentgenologists that the first action of roentgen applications, at least to deeper structures, may be stimulating, and in no condition is this effect so marked as is frequently observed following the first series of applications to an exophthalmic goitre. Roentgenologists are so well aware of this fact that they apply the first and often the second series with extreme caution. It is most likely that Secher's cases were already unrecognized exophthalmic types and not simple goitres, and that the beginning treatment stimulated secretion sufficiently to bring about the phenomena

of Graves' disease. On the other hand, it might be possible in the prolonged treatment of a simple goitre to bring about a condition of hypothyroidism. The author might do well to advise confining roentgenotherapy to exophthalmic goitre, and let the other types alone. Many internists and surgeons who do refer cases of Graves' disease for treatment are not fully cognizant of the fact that roentgenotherapy must be regarded as an adjunct to rest and possibly drug therapy, and that it is not a specific by itself. Failure to appreciate the necessity of enforced rest during early treatment may be fraught with grave danger. A frequent example of lack of knowledge of the action of roentgen rays in Graves' disease is the promise of the internist that the treatment will cause the glandular enlargement to disappear, whereas this is an effect which concerns the roentgenologist not in the least. In the case reported by Secher as having died we are unable to determine whether the patient died following a single series of exposures or after several, as the translator has not made this clear. The possibilities of untoward effects of early treatment and their avoidance have been referred to. It is of course quite possible to go too far with treatment and bring about a condition of hypothyroidism. Both extremes must be avoided as carefully as an overdose of a poisonous drug. A definite percentage of death rate has not deterred the surgeon, neither should a few reported deaths comprising a very much lower percentage act as a damper upon roentgenotherapy. Reference to another article by Nordentoft in the Aug. 29, 1918, issue of the same journal and abstracted in the *Journal of the American Medical Association*, Nov. 16, 1918 (119), will serve to cheer the roentgenologist, as quite another light is thrown on the subject.

In conclusion, let us try to teach our non-roentgenologic colleagues the physiologic action of the roentgen ray, its application to the treatment of exophthalmic goitre, and the necessity for properly handling cases in addition to this treatment.

H. K. Pancoast,
Russell H. Boggs.

PACIFIC COAST ROENTGEN RAY SOCIETY

In spite of the fact that eighteen of its twenty-six members are in service with the colors, a meeting of the Pacific Coast Roentgen Ray Society was held in San Francisco, on Saturday, December 21, 1918. All of the officers excepting the Vice-President, Dr. W. Warner Watkins, Phoenix, Ariz., were in France. The meeting was called primarily to hold the organization together and elect new officers for the coming year.

The meeting was necessarily small, but made up in enthusiasm what it lacked in numbers. Comprehensive plans were made for the year 1919, including a determination to send a large representation to the annual meeting of the American Roentgen Ray Society at Atlantic City. The officers for the ensuing year are as follows:

President: Dr. W. W. Boardman, San Francisco. Vice-President: Dr. Chas. M. Richards, San Jose. Secretary and Treasurer: Dr. Wm. B. Bowman, Los Angeles. Corresponding Secretary: Dr. W. W. Watkins, Phoenix, Ariz. Executive Committee: Drs. Albert Soiland, Lloyd Bryan and Lyell C. Kinney.

C. M. Richards–Sec'y.

TRANSLATIONS & ABSTRACTS

SALMOND, R. W. A. A Technique for the Lateral View of the Upper End of the Femur. (*Arch. Radiol. & Electroth.*, 1918, Vol. XXII, p. 297.)

"The patient lies on the couch in the lateral position, is then securely immobilized by sand bags above and below the knee and across the foot. The patient is next asked to let his body and the lower limb, which is free, swing gently backward; in so doing it will be found that the femur of the immobilized limb does not take part in the movement. What really happens is that the pelvis rotates around the head of the fixed femur and the opposite limb is thus got out of the way. Sand bags or pillows are now placed under the patient's chest and back and around the free limb, to make him comfortable and to keep his whole body at rest. The tube overhead and parallel to the plate and table is then centered over the head of the femur and the exposure made. The extension tube can be brought down to the surface of the skin without interference with the opposite thigh or side of the pelvis. Stereoscopic views can also be taken in this position.

"The result is a true lateral view of the outline of the head, neck and trochanters of the femur, though not, of course, of the pelvis as it has rotated. Because of this, the view cannot be properly described as a lateral one of the hip-joint. As a test that a true lateral view has been obtained, the posterior dense margin of the femoral shaft should be seen running up to and becoming continuous with the outline of the lesser trochanter, and should not be seen running independently across its base."

BROWN, ALEXANDER G. Oral Sepsis and the Cardio-Vascular System. (*South. M. J., Nashville*, Vol. XI, Sept., 1918, p. 601.)

Experimental evidence pointing to the relation of the tonsil infection in the human to heart infection in the animal made the subject of investigation. Causal relation was shown between infection of foci from infected tonsils, pyorrheal pockets, parotid glands, rheumatic fever, and arthritis, endocarditis, pericarditis, and myocarditis. The relation of chronic foci to systemic disease has been demonstrated experimentally.

Clinical evidence shows a cause and effect relation between oral sepsis and heart diseases. The etiologic relation between oral sepsis and arthritis has also been pointed out. Other clinical and therapeutic evidence points to the same conclusion. "In young patients with signs of recurrent endocardial lesions, showing intermittent fever, a low state of vitality, anemia, and under-development, the removal of chronic tonsillar or other oral, nasal, or aural infections, is followed by improvement in strength, growth, and cardiac function. Likewise in adult or aged patients with cardiac weakness (myocarditis), chronic arthritis, general muscular weakness, nephritis, the removal of oral septic foci (pyorrheal abscesses, sinus, or antral infections) is attended by steady improvement in the heart action itself."

Conclusions from the study of evidence, and evidence collected from private personal practice are: Focal infection of the mouth (chronic alveolar abscess, chronic pericementitis, acute and chronic infection of tonsils and other oral, nasal, and aural cavities adjacent) produce serious, dangerous diseases of the heart,—endocarditis, myocarditis, pericarditis, or pancarditis. Disease of important organs of the body must diminish as the profession instructs the laity that the care of the human mouth from focal infection or the early eradication of oral infection when present, is an insurance against many systemic maladies. Thorough mouth inspection should be made on every new patient coming for treatment or diagnosis. Old patients with recurrent diseases should receive careful and painstaking mouth, nasal, and aural inspection, searching for any possible storage of septic bacteria. Dentists must be impressed with the importance of complete and accurate removal of every focus of primary infection, or else secondary metastases can not be improved or cured. Roentgen ray is necessary for detecting foci in roots of teeth, whether crowned or not, in the bone of the lower jaw; but the evidence of gum infection, tonsillar infection, or salivary infection, must be determined by inspection and study by the diagnostician.

PFENDER, CHARLES A., M.D., Washington, D.C. Tuberculous Lymphatic Glands of the Neck Treated by Roentgen Therapy.

The author divides cervical adenitis into three groups: inflammatory, suppurative and sinus cases.

The inflammatory cases, whether large or small, uniformly respond to roentgen treatment, provided any existing trouble in teeth, tonsils or nose is also eliminated. Surgery is contraindicated in these cases.

In suppurative glands a combination of surgery and roentgenotherapy is indicated. The author removes the pus by aspiration instead of incision and then injects the abscess cavity with iodol or creosoted iodoformic oil. After this the roentgenotherapy is instituted.

In sinus or fistulous cases drainage is made as free as possible and the skin is dissected loose about the mouth of the sinus. After this, intensive radiation promptly heals the fistulous tracts.

The author uses the cross-fire method and applies 10 X to 15 X Kienboeck filtered through three to four millimeters of aluminum and three millimeters of leather to each area, and repeats the treatment in from two to four weeks. If the bronchial glands are involved, constitutional effects will be observed unless the dose is reduced to 10 X Kienboeck units. After citing the opinions of some 30 odd authors in reference to roentgen treatments of tuberculous-glands and giving case reports of 10 very interesting cases the author concludes:

1. Roentgenotherapy offers the best results of all the remedial measures now known for the treatment of acute, subacute, and chronic forms of tuberculous cervical glands, both hyperplastic and suppurative.

2. Simple hyperplastic tuberculous glands of the neck should not be treated surgically until roentgenization has been tried. Only when the latter fails is an operation to be considered.

3. Suppurative tuberculous cervical adenitis is best treated by simple incision or evacuation by aspiration, preceded and followed by roentgenization.

4. Suppurative glands with discharging sinuses give the highest percentage of cures when treated by surgical drainage combined with roentgenotherapy. Repeated operated sinuses with failure to cure yield promptly to roentgenization.

5. The conservative treatment of tuberculous cervical glands comprises medicinal, dietetic, heliotherapeutic, and roentgenotherapeutic measures and is followed by ideal results. Surgical measures are merely auxiliary aids in selected cases.

6. Extensive dissection with excision of tuberculous cervical glands is now rarely, if ever, justified.

7. Contraindications to roentgenotherapy do not exist. Local and general improvement of the patient follows proper roentgenization in all varieties of tuberculous glands of the neck.

G. W. GRIER.

BASCH, SEYMOUR. The Differential Diagnosis Between Chronic Gastric Ulcer and Carcinoma of the Stomach. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The contention of the author is that the roentgen ray is not of value in the early diagnosis of cancer of the stomach. He says that its greatest value is in the diagnosis of the more advanced forms and the nature of existing complications. The size, form, position, fixity, tone, peristaltic activity, and relation to other organs, deformities, peristaltic breaks and so on, can be best diagnosed by the roentgen ray. The progress of the disease is also noted. Peristaltic breaks are best observed by screen and filling defects by plates.

LICHTY, JOHN A., M.D., Pittsburgh, Pa. The Incidence of Peptic Ulcer and Carcinoma in the Duodenum. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The author observes that cancer of the duodenum was first described by Hamburger in 1746. Ulcer of the duodenum was first mentioned in 1817. Until about 25 years ago ulcer of the duodenum was not a popular diagnosis. Now it is the most frequently recognized lesion in the gastrointestinal canal. In a series of 808 cases of cancer of the intestine Nothnagel found only 4.5 per cent. in the duodenum; while statistics show that of cancers in general, only .34 per cent. occur in the duodenum.

In a series of 486 patients with duodenal lesions, six were found to have cancers. Of these six, the cancer in two was in the pyloric ring and in four at the papilla of Vater. Moynihan says that 90 per cent. of the ulcers are found in the

first inch and a half of the duodenum. Apparently then, cancer is not found in the same area as ulcer. He asks the following questions: "If carcinoma of the stomach so frequently arises from a peptic ulcer, why doesn't carcinoma occur more frequently in the duodenum where peptic ulcer abounds? Is it not probable that the etiological and determining factor of carcinoma of the stomach is something entirely independent of peptic ulcer?"

BARRINGER, BENJAMIN S., M.D. Surgery Vs. Radium in the Treatment of Carcinoma of the Bladder. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The author states that there are two types of carcinoma of the bladder. First, the papillary type which projects into the bladder; second, the indurative type which extends through the bladder wall and thence outward. He considers the urinary bladder an unfavorable field for surgery on account of the difficulty of reaching the neck and the trigone where 80 per cent. of the tumors are found. The constant motion of the bladder is regarded as a hindrance to surgery as it interferes with the healing after the operation. He looks upon the bladder as a unique field for radium. The motion does not interfere with the action of the radium, and the urine acts as a filtration screen.

BOGGS, RUSSELL H. The Comparative Value of Radium and Roentgen Radiation. (*Pa. J. of Roentgenol.*)

When radium is placed in contact with the tissues it is effective only for a depth of about one inch. Deeper effect can only be produced by removing the radium to a distance and cross-firing. This is not practical, because the supply of radium is too limited to get large enough doses with the radium placed at a distance from the part to be treated. Therefore, in a general way, when a local action is desired radium is preferred, and when large areas are to be treated roentgen rays are preferred. Small doses are stimulating, large doses destructive. The latent period after application varies with the size of the dose; the larger the dose, the shorter the latent period. Gland cells are very sensitive to the action of the rays; cartilage is little affected. Endothelium of the small vessels is very sensitive and swells enormously under small doses, while larger doses destroy it completely. This susceptibility is greater toward radium than toward roentgen rays. Sarcomatous tissue in glands is more easily destroyed than metastatic carcinomatous glands. Tubercular adenitis responds more quickly than metastatic carcinoma, but not so quickly as sarcomatous glands, although the result in sarcoma is often only temporary. An epithelioma on a mucous membrane is more malignant than one on the skin and will require more treatment.

Carcinoma of the Uterus.—Up to the present radiotherapy has only been employed in inoperable or recurrent cases. After radium treatment the bleeding ceases, the offensive discharge increases and becomes odorless, the cancerous mass diminishes in size and sometimes entirely disappears. When the pain and discharge cease, the general health improves rapidly and the patient recovers for a time at least.

Technique.—Less than 50 milligrams should not be used, and within the first week or ten days from 2,000 to 4,000 milligram hours should be given. This may all be given at one time, or it may be divided up into six or eight doses. The result seems to be about the same. The roentgen rays should be applied externally at the same time.

Carcinoma of the Rectum.—Results are not nearly so satisfactory as in carcinoma of the uterus. A proctitis always follows treatment if large enough doses are given, and a colostomy is necessary to prevent irritation of the inflamed area.

Epithelioma.—When situated on mucous membranes, radium is better than roentgen rays. The virulence of an epithelioma depends on the richness of lymphatic supply at the region where it is located. The prognosis depends on the variety, extent, duration and rapidity of the process. Epitheliomas of the lower lip treated by radium with the roentgen ray applied to the glands, do better than by surgical treatment alone where the recurrences reach 50 to 75 per cent.

Sarcoma in the nasopharynx responds well to radium treatment. Carcinoma in the mouth and throat does not do as well under radium treatment as sarcoma, but some good results have been obtained. If the ulceration is confined to the mucous membrane it responds well,

but if muscle tissue is involved it is very resistant. In such cases electric coagulation following a full radium treatment is usually successful.

Carcinoma of the Breast.—Following operation, a full physiological dose should be given to the area involved and over all the lymphatic chains draining that area. These are the axillary, supra-scapular, anterior pectoral of opposite side, internal mammary, sub-scapular, paravertebral, xiphoid and inguinal groups. Metastasis occurs more quickly in the young and in the fat, on account of the richer lymphatic supply. Radiotherapy produces a sclerosis of the lymphatics and therefore retards metastasis.

G. W. Grier.

Hinman, Thomas P. Discussion—Symposium on Oral Sepsis. (*South. M. J., Nashville,* Vol. XI, Sept., 1918, p. 613.)

The question of what should be done with bad or dead teeth and how they should be handled is being worked out scientifically by the Research Institute of the National Dental Association. Every gold crown ought to be suspected. The day is coming when gold crowns will no longer be seen. The methods that have been used in filling root canals did not prevent infection but at present the methods used do prevent infection of canals.

Bailey, Harold. Radium in Uterine Cancer. (*Surg., Gynec., and Obst.,* June, 1918, Vol. XXVI, No. 6.)

Although the radiotherapy of uterine cancer of the inoperable type is more than justified as it causes amelioration and often a standstill of the symptoms, the technic of its application in operable cases has been hazardous due to the lack of a clear understanding of the methods of standardization.

During a period of two and a half years at the Memorial Hospital, New York, the author has had under radiation at various times about 120 cases of uterine cancer and has improved the technic of the application in a marked degree. In 1915 the technic was the French method with massive dosage and the radium was applied by means of the usual applicator, consisting of a small lead capsule about 2½ mm. thick and 2½ cm. long.

Beside the uterine and vaginal application rectal treatments were also made and a combination of roentgen-ray treatments and radiotherapy was given in a number of cases with good results.

In 1916 a change in technic was made. Instead of the old lead filter a platinum filter was applied which caused less irritation of the surrounding organs. The capsule was inserted in the uterus and the cross-firing method abandoned. Repeated treatments with the radium applicator in the same place caused a local necrosis of the cervix, making necessary the use of an improved applicator. This consisted of a solid lead globe, 3½ cm. in diameter with the one pole removed and forming a receptacle for the platinum capsules. But even so the secondary rays from the lead globe caused considerable irritation to the neighboring parts and this led to the making of a further improved applicator, the "mercury bomb." In this, mercury was used as a filter—a thin capsule of iron, 3½ cm. in diameter, filled with mercury. The top of the capsule had a receptacle of lead wherein the platinum tubes were placed and all was covered with a rubber cap. At the lower end was fastened a wire for directing the apparatus. The thickness of the mercury at the projecting end was 1 cm. and behind, 2 cm.; and the rough measure of the ionization of the radium through 1 cm. of mercury was found to be 1 per cent. With this mercury bomb two objects were accomplished: cross-fire treatment from within the cervix and radiation for quite a distance into the pelvis. In the vaginal applications the bomb is directed toward the lesion on the cervix and later on towards the right and left parametria, held in position by strapping the wire-stem to the patient's thigh. Besides the vaginal treatment the lower abdomen also is treated with the same mass of emanation. Here the radium is placed in a wooden receptacle 4 cm. thick and lined and covered with a 3 mm. thickness of lead. It is the author's opinion that the initial dose must be high and not repeated over the same area. The cross-firing should be made use of from within and from the surface of the body. By using the mercury bomb the harmful effects from unfiltered rays are eliminated and the treatments should be completed as soon as possible so that the time of the second application will not coincide with the irritative effects of the first.

Peer Lund.

CLARK, JOHN G. The Therapeutic Use of Radium in Gynecology. (*Surg., Gynec., and Obst.*, June, 1918, Vol. XXVI, No. 6.)

In his article the author reviews his results of radiotherapy in two types of cases, the myopathic hemorrhages of benign origin near the climacteric, and cases of inoperable cancer of the cervix and vagina. He reports in all one hundred cases of each class, and draws the following conclusions.

In cases of benign uterine hemorrhages radiotherapy is found easily competing with the surgical procedures.

Radium was applied to women where no tumor was palpable, but dysmenorrhea was present. If a massive tumor was present, with resultant inflammatory conditions, an abdominal operation was always advised; and in young women, where a myomectomy is possible.

Radiotherapy is to be employed in fibroma patients of the following two classes: (1) To women with benign myopathic hemorrhages and in women over 40 years of age in whom it is desired to bring on the menopause. (2) In small doses to young women with excessive menses with very small myomata, and cases of polypoid endometritis.

Radium should not be employed when the tumor is larger than a three to five months gravid uterus; or in young women with a single easily removable myoma, where a premature menopause may be the result, if dosage is not carefully watched.

Technic of application: after curettage, radium, protected by platinum and rubber, is inserted in the fundus of the uterus, dosage being an average 50 mmllgr. for 24 hours. Success was obtained in all the cases but two, one of which was a chronic pelvic inflammation and the other a case of multiple myomata.

In cases of cancer of the cervix or vagina the radiotherapy is somewhat more uncertain, but in 52 per cent of the cases a local cure was effected; 60 per cent were relieved for the more or less profuse hemorrhages and in many cases the pain was checked.

If a case has been locally healed by radium it is contrary to his belief to attempt surgical interference.

It is always difficult to determine which cases are amenable to radium. While it is the treatment of choice in cancer of the cervix or vagina, hysterectomy is undoubtedly the correct procedure in cases of cancer of the fundus.

PEER LUND.

PRICE, W. A., AND POND, SAMUEL E. Electrolytic Medication. (*J. Nat. Dent. Ass.*, Vol. 5, Aug., 1918, p. 855.)

Evidence is given on (1) the direct action of electrolytes, electric current, and electro-chemical products upon bacteria—(2) whether or not the current reaches the tissues involved. It has been assumed by those using "Electrolytic Medication" that (a) electrolytes or ions, (b) electric current, and (c) the electrolytically precipitated elements killed bacteria. In the research, no evidence was found to support these views. It seems there is no *direct* action leading to disinfection under present practice. Further, the energy which had been believed to be expended on the pathological tissues about the apex, has been found to be expended on the normal pericemental tissues about the lateral root walls. If there is a beneficial action or disinfection, it must be indirect. It may be possible to perfect an electro-chemical method as an efficient agent for the sterilization of tooth and supporting tissues.

BYRON C. DARLING, M.D.

MERRITT, ARTHUR H. The Pathology, Etiology, and Treatment of Pyorrhea. (*Dental Cosmos*, Vol. LX, July, 1918, p. 574.)

The pathology of pyorrhea alveolaris is described. There are two etiological factors: predisposing and exciting. Predisposing causes are systemic diseases, localized malnutrition due to lack of mastication, frail bony investment of the teeth, and occlusal trauma. Exciting causes are those which irritate the gingiva, exposing the tissues to infection. Uncleanliness of the mouth and faulty approximal contact-points cause this initial irritation. In treating pyorrhea, the etiological factors should be considered and corrected. Pyorrhea is a curable disease but patients affected may not always be cured. A most exacting technic is necessary. Treatment consists in correcting the occlusion and establishing normal nutrition in the investing tissues. In treatment, good root surgery is necessary. It has been asserted that "suppurative detachments of the peridental

membrane are permanent detachments." This is not true. Such a reattachment takes place as a rule in the hands of a skillful periodontist. The fact that reattachment never takes place about non-vital teeth that have become septic indicates that in some way, not understood, the pulp is the controlling factor in the vitality of the cementum. The absurdity of destroying the pulps in treatment of pyorrhea is apparent.

HARTZELL, THOMAS B. The Clinical Type of Arthritis Originating About the Teeth. (*J. Am. M. Ass.*, Vol. LXV, Sept. 25, 1915, p. 1093.)

In 220 patients studied, ***streptococcus viridans*** was found in the dental abscess and in the superficial tissues of the peridental membrane; this condition was associated with joint infection. Of twenty vital teeth extracted and examined, ten contained living pulp entirely germ free; the other ten offered growth of ***streptococcus viridans***.

Arthritis of dental path origin is characterized by slow onset with exacerbations and remissions; these exacerbations seem coincident with the filling to distention of dental abscesses or retention of pus from deep pyorrhea pockets draining directly into the circulation.

Treatment of pyorrhea pockets by curettage and evacuation of dental abscesses has an effect like that of vaccine (inoculating the patient with a large number of organisms). By this treatment the supply from the focus is shut off. When many pyorrhea pockets or abscesses occur, it is important to permit from three to six days to intervene between treatments, which brings a constant gain generally ending in cure. If sudden complete extirpation of all foci, *e.g.* extraction of all the teeth at once is practiced, the end result will be positive harm.

Early elimination of foci in arthritis of dental origin renders it easy to control. If such foci are active for a considerable time, elimination of the foci, while limiting progress of the disease, will not repair it.

MYER, K. F. The Present Status of Dental Bacteriology. (*J. Nat. Dent. Ass.*, Vol. IV, Aug., 1917, p. 966.)

A full critical review is made of recent literature on the microbiology of the mouth under three heads:

(1) Bacteriology and protozoölogy of the mouth cavity.
(2) Microbiologic studies in relation to dental caries.
(3) Bacteriology of oral abscesses, chronic periosteitis, and osteitis dentalis, and their importance as foci of systemic diseases.
(4) The etiology of pyorrhea alveolaris from the viewpoint of recent bacteriologic and protozoölogic studies.

BYRON C. DARLING, M.D.